Report ETL-TR-71-5

SURFACE CLIMATE OF THE ARCTIC BASIN

Selected Climatic Elements Related to the Performance of Surface-Effect Vehicles

by

Andrew D. Hastings, Jr.

December 1971

U.S. ARMY ENGINEER TOPOGRAPHIC LABORATORIES
FORT BELVOIR, VIRGINIA

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Distributed by

The Commanding Officer
U. S. Army Engineer Topographic Laboratories

Prepared by

Andrew D. Hastings, Jr.
Geographer

Earth Sciences Division
Geographic Sciences Laboratory
U. S. Army Engineer Topographic Laboratories
Fort Belvoir, Virginia

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ON 10

(Thru USA Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire)

SUMMARY

This report is primarily an atlas of thematic maps illustrating the distributions and frequencies of occurrence of monthly climatic means and extremes within the Arctic Basin. Mapped elements include Mean Daily Maximum and Minimum Temperatures, Absolute Minimum Temperature, Mean Dewpoint, Mean and Maximum Windspeeds, and Horizontal Visibility Restriction. These elements were selected because of their significance with respect to the design and operation of large Surface Effect Vehicles. Sixty of the maps depict 5 F° intervals of various temperature measurements or 2-mph intervals of mean windspeed as oceanic isopleths in monthly series. Four maps display annual histograms showing the monthly march of frequency of days with low temperatures, high winds, or restricted visibility and maximum windspeeds for selected stations. The distributions are derived from shore station data and observations from nearly 40 drifting ship and ice stations and over-ice traverses spanning the last century of scientific research in the Arctic Basin. The bulk of the data, however, comes from Soviet and United States drifting ice stations which were maintained during the last two decades. Many of the data have not heretofore been utilized in published materials; consequently, tables of all summarized data resulting directly from this research are included as an appendix.

FOREWORD

This report has been prepared by the Earth Sciences Division, Geographic Sciences Laboratory, U. S. Army Engineer Topographic Laboratories, at the request of the U. S. Army Cold Regions Research and Engineering Laboratory which has been assigned, by Advanced Research Projects Agency, the task of collecting data pertinent to the design and operation of large, Surface-Effect Vehicles in the Arctic under ARPA Order No. 1615. The purpose of this report is to summarize the distribution and frequency of occurrence of certain climatic conditions in the Arctic Basin. Particular emphasis has been placed on data from Soviet and United States drifting ice stations which have operated within the Arctic Ocean and its peripheral seas during the last two decades. Research commenced on 1 July 1970 and was concluded on 30 June 1971. Andrew D. Hastings, Jr. was the responsible investigator working under the supervision of Dr. William C. Robison, Acting Chief, Earth Sciences Division, with scope guidance from the Project Leader, Dr. Charles M Keeler, Cold Regions Research and Engineering Laboratory.

CONTENTS

SURFACE CLIMATE OF THE ARCTIC BASIN

1. Introduction.

The purpose of this study is to summarize, by maps and graphs, certain climatological elements which are considered to have important effects on the operation of Surface Effect Vehicles within the Arctic Basin. Accordingly, the map information is confined to the boundary layer parameters of wind, temperature, humidity, and visibility. Many of the data have not previously been used in analyzing Arctic Basin climate; thus, the maps presented here are probably the most reliable to be found even though some of the records are fragmentary and disappointingly short.

2. Methods.

a) Availability of Meteorological Data. (See Appendix A.)

Data were gathered from drifting ship and ice stations and over-ice traverses within the Arctic Basin as well as from peripheral shore stations whose instrument elevations approximate sea level. Shore station data are relatively plentiful and generally available through a variety of standard published sources. Information from drifting stations within the Arctic ice pack is not so uniformly accessible.

Observations from the early ship expeditions between 1872 and World War II are mostly found in comprehensive, hard-bound reports, often as separate volumes treating the investigations of discrete scientific disciplines such as climatology. Observations at U. S. ice island stations commencing in 1952 are available, with some notable exceptions, in governmental contract reports dealing with particular periods of occupancy under shifting patterns of scientific emphasis and agency sponsorship. Some records covering rather substantial periods have never been published and are available only in the form of original WBAN-10 daily weather observation forms or manuscript field notes from the responsible observers.

Prior to 1961, the Soviet Union published a number of journal articles containing data from their manned ice-floe stations in the "Severnyi polius" (Northpole) series, Northpole I (Papanin Expedition, 1937-38) through Northpole 9 (1960-1961). Since then, data from subsequent stations, Northpole 10 through Northpole 20, have not appeared in the open literature despite the fact that a continuing systematic program has maintained 2 or 3 stations at a time during most of the ensuing period. At the present writing, it is understood that Northpole 16, 18, 19, and 20 are still operative. All of these manned stations transmit periodic weather data and position reports by radioteletype and these are received through normal monitoring facilities in Alaska and northern Canada. Thus, it has been possible to obtain encoded printouts (unedited) through 1970 for the purpose of this study.

The Union of Soviet Socialist Republics has also scattered a larger number of temporary stations known as the "Severnyi" (North) series. These operate for brief periods, usually in early summer, with intensive air support. There are, in addition, a very large number (perhaps more than 300 at any given time) of automatic stations which communicate stored data upon remote radio interrogation of their taped records. These are distributed off the Siberian coast to about 85°E. and 170°W. They comprise two types, the so-called "DARMS" (Drifting Automatic Radiometeorological Stations) and the older Alekseyev Radio Beacons, all utilized primarily for daily synoptic reports affecting the Soviet mainland. The automatic stations have relatively short operational lives, averaging scarcely 100 days, owing mainly to the hazards of floe break-up in this section of the basin. Inasmuch as neither the automatic stations nor temporary stations in the "North" series broadcast on a scheduled basis, it is impossible to assemble usable monthly summary data from them in the absence of published reports.

U. S. Air Force dropsonde data over the western basin, mainly from the so-called "Ptarmigan" flights of the 1950s, were examined but rejected due to enormous problems of establishing meaningful plot positions for a given month of related observations and the uncertainty of altitudes at which the lowest level readings were transmitted.

Apart from long-term records at shore stations, the most usable data were derived from unsummarized individual observations, generally 2 to 8 per day, from manned drifting stations. Many of these have never before been reduced to monthly values nor published in any form. Thus, it became a basic requirement of this study to locate several widely-scattered private sources of unpublished daily data and to obtain machine printouts of those remaining data received through teletype intercept and stored at U.S.A.F. Environmental Technical Applications Center in Asheville, N. C. The nature of these essentially unedited data has required a number of personal judgments with respect to obvious errors in transcription of encoded meteorological data and grid coordinates. Nonetheless, it is felt that secondary errors generated by this process will have been reduced to virtual insignificance through summarization and a scheme of station clustering to be described later.

b) Data Plotting.

The base map utilized for these analyses was the 1:5,000,000 scale USAF Global Navigation and Planning Chart, GNC-1N, a Transverse Mercator projection (revised March 1968) with true linear scale along the 90th meridian. This was selected both for its general size-scale suitability and for the currency and conformality of its coastline information.

Mean monthly positions for all drift stations with available meteorological data were established in one of two ways. Wherever mean monthly plots were given together with weather data in published sources they were used directly. Otherwise, mean positions were calculated by averaging latitude and longitude separately from daily fixes. In the cases of certain recent Soviet stations which have zig-zagged back and forth across the International Date Line, the coded teletype symbols for East and West Quadrants are clearly in error. They are occasionally reported as values in excess of 180° Longitude and are often mixed with conventional notation. Only by first plotting the daily course of individual coordinate pairs can the errors be detected and a plausible track established.

Figure 1 locates all mean monthly drift station and over-ice traverse positions. The keyed interconnecting lines must not be construed as actual drift tracks. They are included merely to simplify the locating of successive mean monthly positions in a related series. Only in a very crude way do they approximate the intricately wandering courses of the true drift tracks. Much in the manner of running means, it is only fortuitous if a monthly mean position happens to coincide with any real position of the station along its precise line of drift.

Prior to data plotting, separate monthly plot templates were prepared on stable film stock, each locating the mean positions of all drift and over-ice traverse stations for a particular month together with the fixed positions of all shore stations to be used. These were used repeatedly to produce the multiple overlays of meteorological data plots.

Inspected individually, the monthly plot templates reveal virtually no real concentrations of positions although they are less dense in the peripheral seas than in the Arctic Ocean proper. In view of the sparseness of the data, this is perhaps fortunate; but, at the same time, it may be regretted that there are no really tight clusters from which to obtain real confidence in the long-term means or extremes. We can only hope that we are dealing with great areas of such general climatic uniformity that the short-term record (few stations in larger area groupings) does not deviate importantly from the long-term record.

Due to the prevailing clockwise water circulation around the Beaufort Sea, few stations have drifted across the middle of that area (one each by T-3 and ARLIS I). Similarly, the orientation of the cross-polar ocean current from the Chukchi Sea across the Pole to the East Greenland Sea tends to steer the ice pack (hence drift stations) away from the Laptev coast of Siberia. Considerable numbers of stations were first established in springtime in the vicinity of 75° North, between 160° and 180° West. This has created some loose clustering of early summer data in that area. With each succeeding month, the tendency for these clusters to move in a general poleward direction becomes less pronounced; and, after the lapse of about one year, the diffusion is so great that the clusters can no longer be distinguished.

Island stations in the Kara Sea more than compensate for the lack of drift station records there. Both the Kara and the Laptev Seas are crossed by the shipping route from Murmansk to the Bering Sea so there are, of course, plentiful shipboard weather records available. Nonetheless, the season is short (mid-July to mid-September) and the relatively swift passage of vessels renders monthly data summaries meaningless in terms of mean monthly ship positions. Still, the sparseness of monthly data here and in the other peripheral seas should not significantly diminish confidence in the resultant analyses because the plotting network is tied nearby to the more reliable ring of shore stations.

From this standpoint, after grouping data by ocean areas, the overall reliability of analytical lines in this atlas is considered to be fair to good (based on a 5-year minimum period of record); it is probably poorest in that area lying just north of Spitzbergen between Greenland and Franz Joseph Land where island station records are short and outdated. At the present rate of data acquisition, predominantly by the Soviets, it may take another 20 years to accumulate sufficient surface information to upgrade our knowledge of Arctic Basin climate to the status of genuine reliability (barring significant climatic change). For the time being, it is somewhat reassuring to realize that 80 percent of the available data has been accumulated in the last two decades.

After the data were compiled and tabulated into monthly summaries, they were transferred to fairsheet overlays registered to their respective monthly position plot templates. All data calculations deemed to be of any credibility were plotted on these fairsheets. Those which represented seriously incomplete months (fewer than 25 days of record) or were otherwise questionable were separately distinguished and usually not included in the averages for ocean areas.

Twenty-one uniform ocean areas approximately 300 statute miles square were arbitrarily laid out over the Arctic Ocean area of the base map. For all of the monthly isoplethic maps in the atlas, the ocean area was analyzed in the following manner. Data appearing within each of the 21 ocean areas (usually 5 to 9 values) were combined to make a composite record represented by the center of the square. This was varied in the case of extreme minimum temperatures wherein the exact location of the lowest temperature in or immediately adjacent to the square was used instead of the center point. These composite values together with those of the longest available records at shore stations comprised the analytical network for each isoplethic fairsheet. Thus, it may be said that the resultant isopleths are, with few exceptions, based upon a minimum of five years of record at points not more than 300 statute miles from their nearest neighbor.

For the special purposes of the histogram maps, it was found advisable to make composites from larger ocean areas. To this end, 16 of the most centrally located of the original 21 squares were divided into groups of four each which were approximately 600 statute miles square. While usable data were less abundant for these elements, nonetheless, the larger ocean areas are each represented by 7 to 16 values (a minimum 7-year period of record).

3. Comments on Isoplethic Maps. (See Appendix B.)

a) Mean Daily Maximum Temperature (Figures 2 - 13).

Viewed as a whole, the Arctic Basin is coldest in February when mean daily maxima fall below -30°F in the sector between Ellesmere Island and the Pole. It is warmest in July when mean daily maxima are above freezing in all areas except the cold node off Ellesmere. The first thawing (32°F) isotherm of the warm season appears in the Greenland Sea in May and is last seen in October in the Barents Sea. The zero (F) isotherm disappears by May and reappears in October off Ellesmere.

b) Mean Daily Minimum Temperature (Figures 14 - 25).

The lowest mean daily minimum isotherm, -40°F, appears in January along the littorals of eastern Siberia and the Canadian Arctic islands; it expands in February and wanes through March. July mean daily minima remain below freezing over most of the basin, but scarcely below 30°F. Freezing isotherms appear in June along the Siberian and Beaufort coasts and disappear in September. The zero isotherm of mean daily minimum temperature performs much like the zero mean daily maximum line, disappearing by May and reappearing in October off Ellesmere.

c) Extreme Minimum Temperature of Record (Figures 26 - 37).

The coldest isotherm, -65°F, appears in February (Figure 28) along the perimeter of the Canadian Arctic Islands and in a pocket astride the International Date Line between Wrangel Island and the Pole. July minima are all below freezing with areas as cold as +15°F in Franz Joseph Land. While the zero minimum isotherm has not yet been reached in May, all minima throughout the basin are above zero in June. It reappears in September to encompass most of the basin.

d) Mean Dewpoint Temperature (Figures 38 - 49).

Lowest dewpoints of the year occur in January, the minimum being -45°F in the area of Eureka Inlet, Ellesmere Island. Highest values are reached in July when dewpoints in the upper 20's in the central basin are the lowest to be found (Figure 45). The freezing line appears first in June and disappears in September. The zero dewpoint line disappears by May and reappears in October.

e) Mean Windspeed (Figures 50 - 61).

Mean windspeeds are remarkably constant throughout the year. The bulk of the basin averages less than 12 miles per hour from December through August. Even during the windiest month, October, wind speeds average less than 15 miles per hour over most of the basin. The windiest areas (seldom averaging greater than 20 mph) are in the Kara Sea around Novaya Zemlya, the Bering Strait, and, to a lesser degree, in the New Siberian Islands. Lowest mean wind speeds (generally less than 4 mph) are encountered in the Canadian Arctic Islands, principally in the vicinity of Parry Channel throughout the year.

4. Comments on Histogram Maps. (See Appendix B.)

a) Maximum Windspeed of Record (Figure 62).

Greatest steady windspeeds (not gusts) are seen to occur along the peripheral coasts of the basin. Hurricane force winds (75 mph) are not uncommon in Arctic coastal records and the station of Russkaya Gavan on Novaya

Zemlya has recorded 90 miles per hour or greater in all five months from December through April. In the central basin, maximum recorded surface winds are generally below 50 miles per hour.

b) Frequency of Occurrence of Temperatures ≤ -25°F (Figure 63).

The greatest frequency of days with low temperatures occurs along the perimeter of Canadian Arctic Islands. Temperatures at or below -25°F occur there and over most of the central basin on 105 to 140 days annually.

c) Frequency of Occurrence of Winds ≥ 25 mph (Figure 64).

In the central basin, 14 to 23 days per year experience winds of 25 miles per hour or greater. All shore stations surrounding the basin exceed 25 days while stations in Spitzbergen and East Greenland exceed 100 days annually. Curiously, at Russkaya Gavan, where the greatest windspeeds have been recorded, speeds of 25 miles per hour are only equalled or exceeded on 69 days per year.

d) Frequency of Occurrence of Horizontal Visibility Restriction to One Statute Mile or Less (Figure 65).

Poor horizontal visibility is generally as frequent over the pack ice of the central basin as it is along much of the littoral, averaging 72 to 108 days per year restricted to one statute mile maximum. Substantially greater frequencies do occur in the Chukchi and Kara Seas and parts of the Canadian Arctic Islands (up to 189 days annually); whereas, much lower frequencies are encountered around the Greenland Sea (less than 35 days). There is considerable variability of regime, but highest monthly frequencies should be expected in the summer, particularly within the basin.

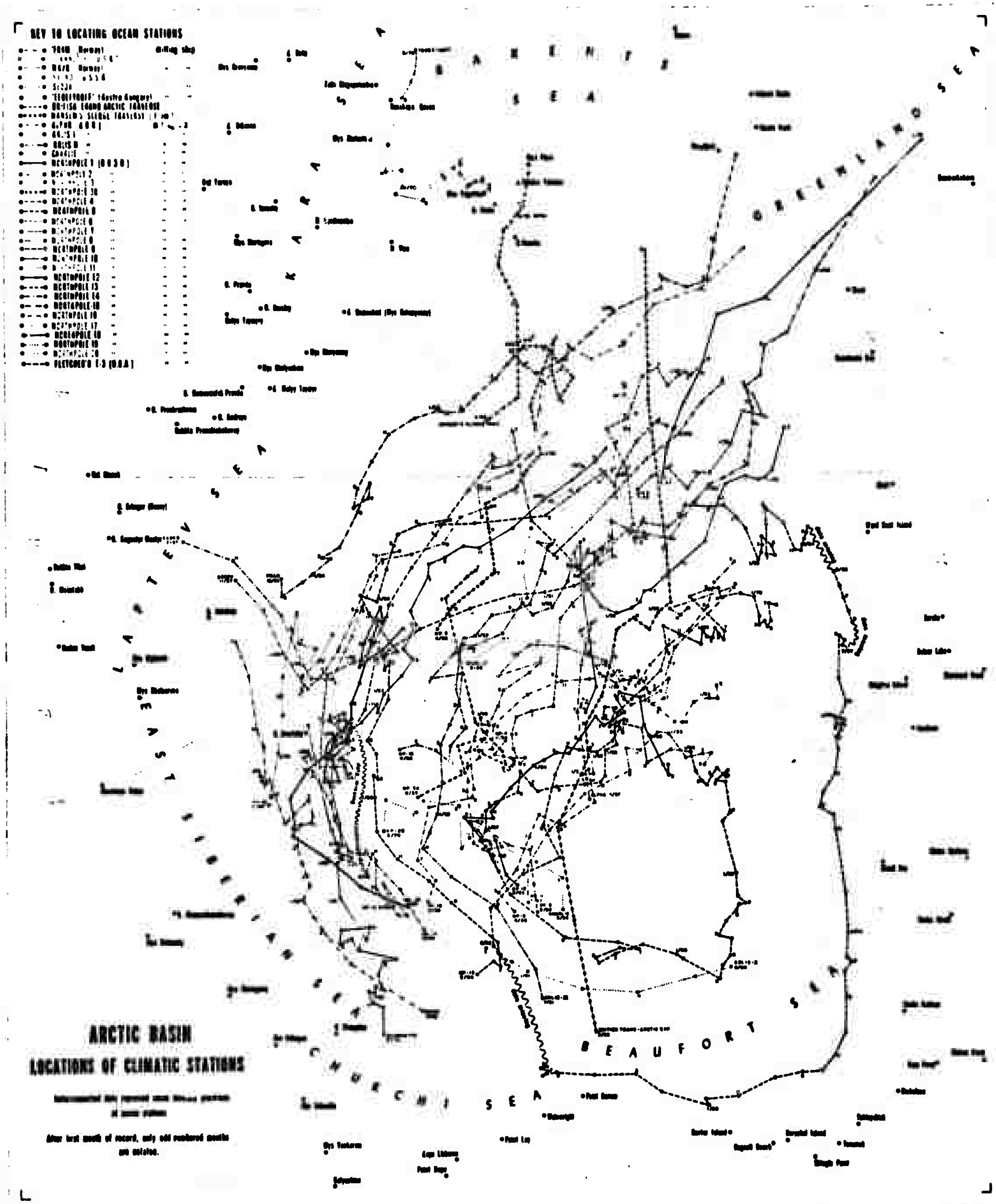
5. Comments on Frequency of Occurrence of Hydrometeors.

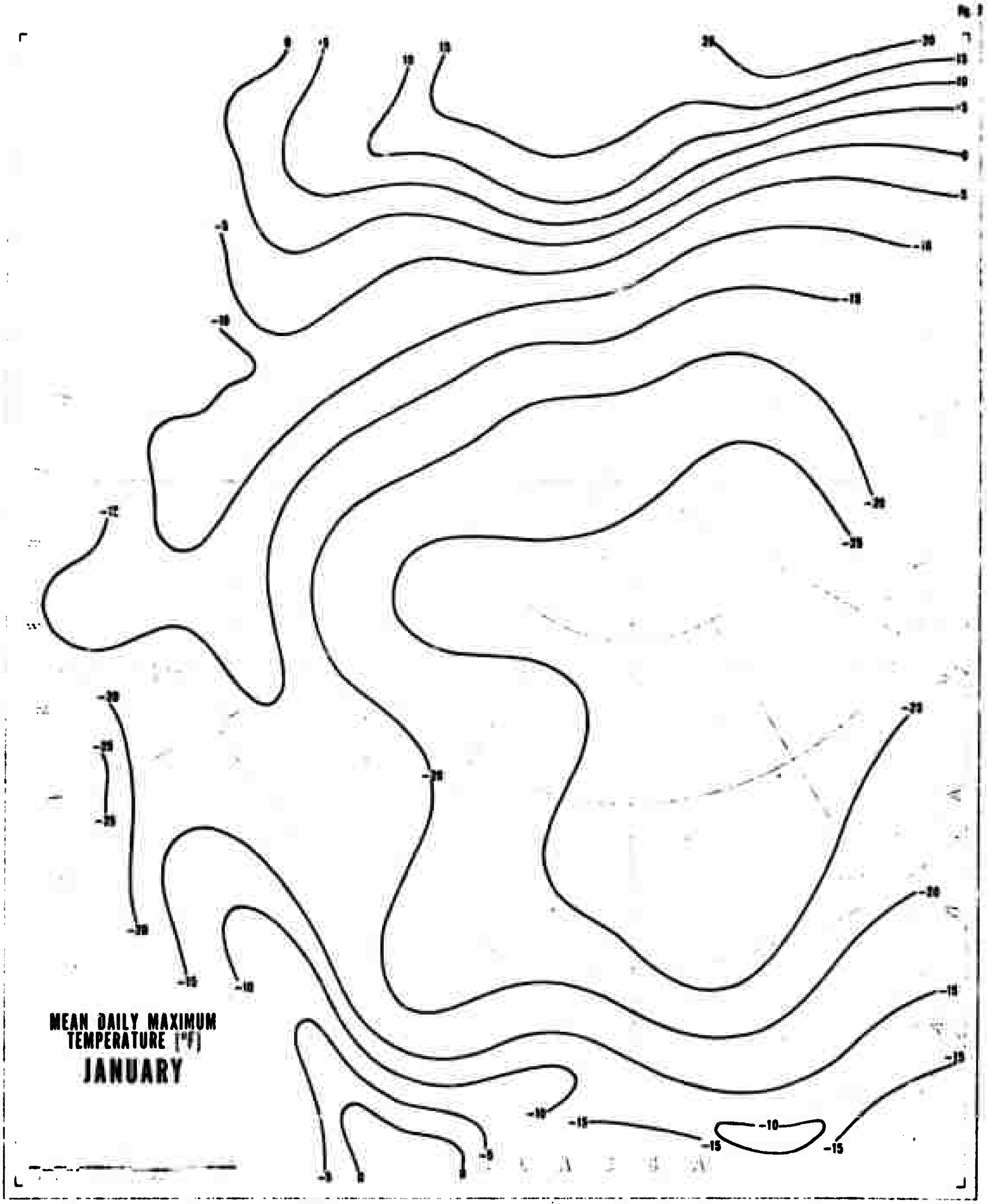
Figure 66 illustrates the occurrence of various forms of precipitation which may be encountered on the ice pack throughout the year. Based on two consecutive years of data from Ice Island "T-3" while the station stayed within 330 miles of the Pole, the following generalities can be stated. Snow or sleet fell during every month, greatest in winter (49% in Dec.) and least in early spring (4% in Mar.). Rain, freezing rain, or drizzle occurred from May through September (17% of the time during July, when snow or sleet fell 21% of the time). Fog, limiting horizontal visibility to one mile, occurred in small amounts in all months except January, greatest (nearly 15% of the time) during September. Other restrictions to visibility (apart from darkness) including all forms of precipitation and blowing snow occurred in frequencies ranging from 2 percent in May to 10 percent in September. There was one unseasonal occurrence of rain recorded in November.

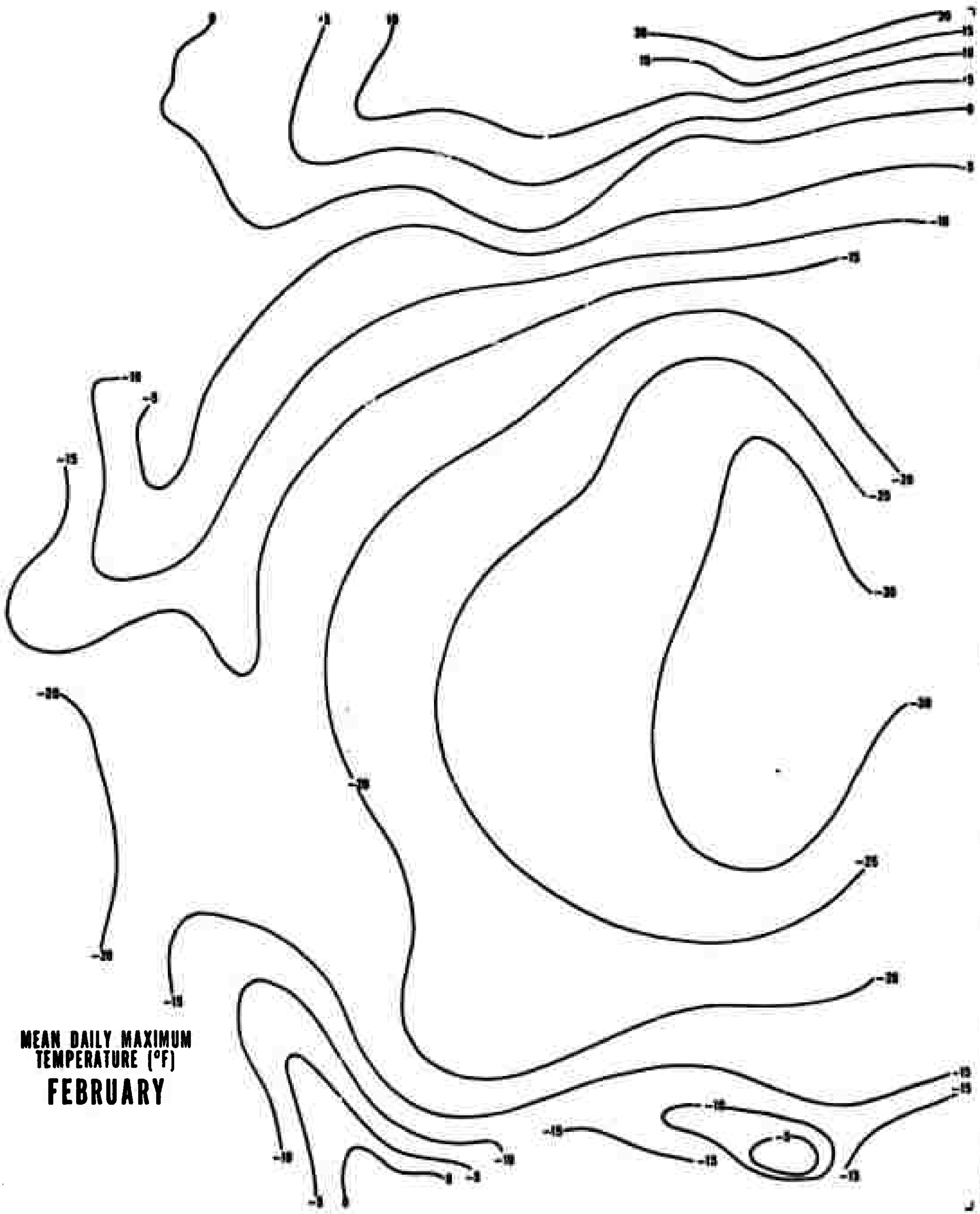
6. Map and Graph Figures. (See Appendix C.)

Footnote: Certain maps among those of Mean Daily Maximum Temperature, Mean Daily Minimum Temperature, and Mean Dewpoint Temperature show areas where temperatures are above the freezing point. On these maps, the 32°F line has been added to the sequence of 5-degree intervals. It is represented as a dashed line solely to distinguish the freezing isotherm from the rest and in no way implies less reliability than the solid lines.

Fig. 1

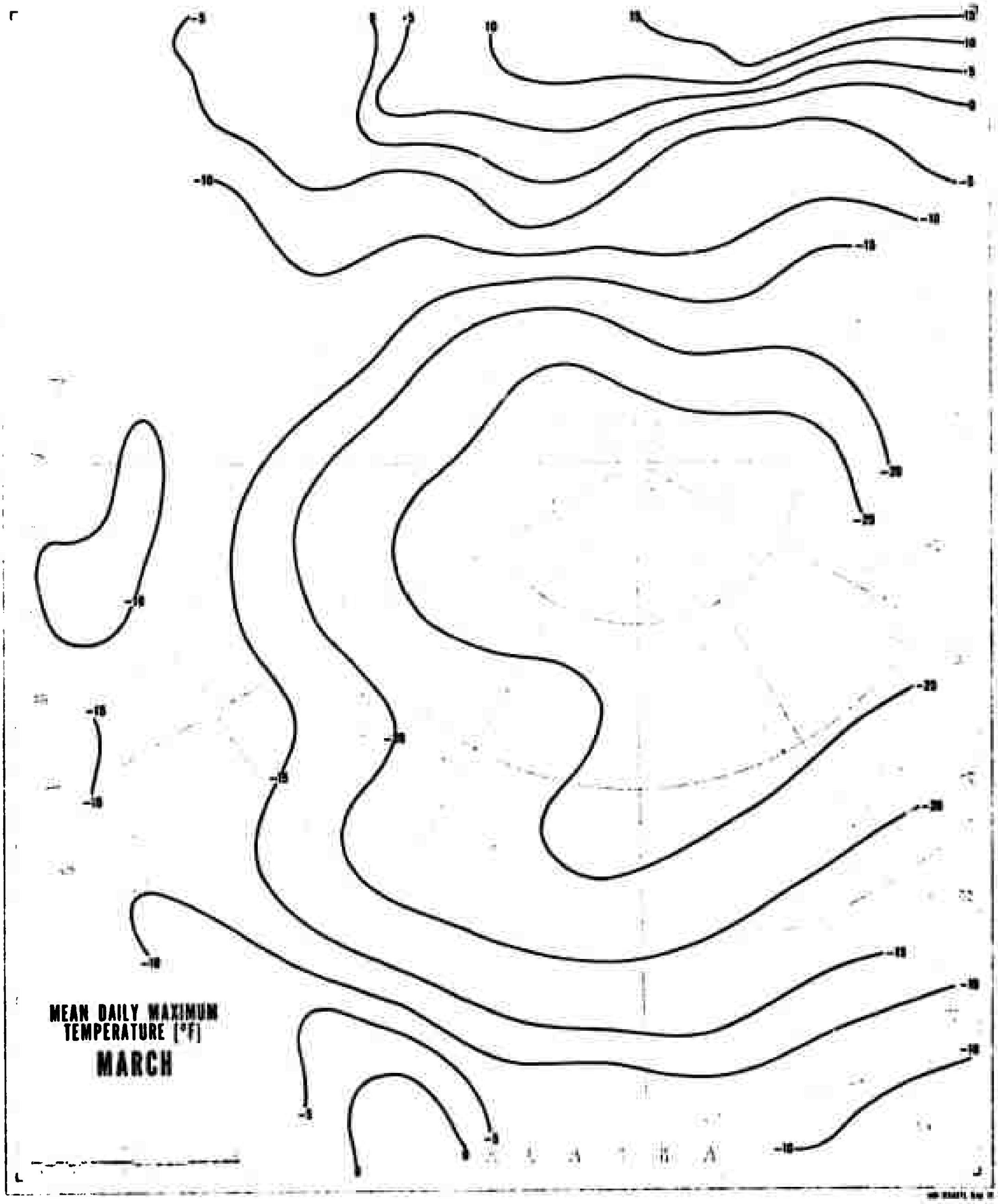

BARENTS SEA
GREENLAND SEA
KARA SEA
LAPTEV SEA
EAST SIBERIAN SEA
CHUKCHI SEA
BEAUFORT SEA
ARCTIC BASIN
LOCATIONS OF CLIMATIC STATIONS
After first month of record, only odd numbered months are plotted.

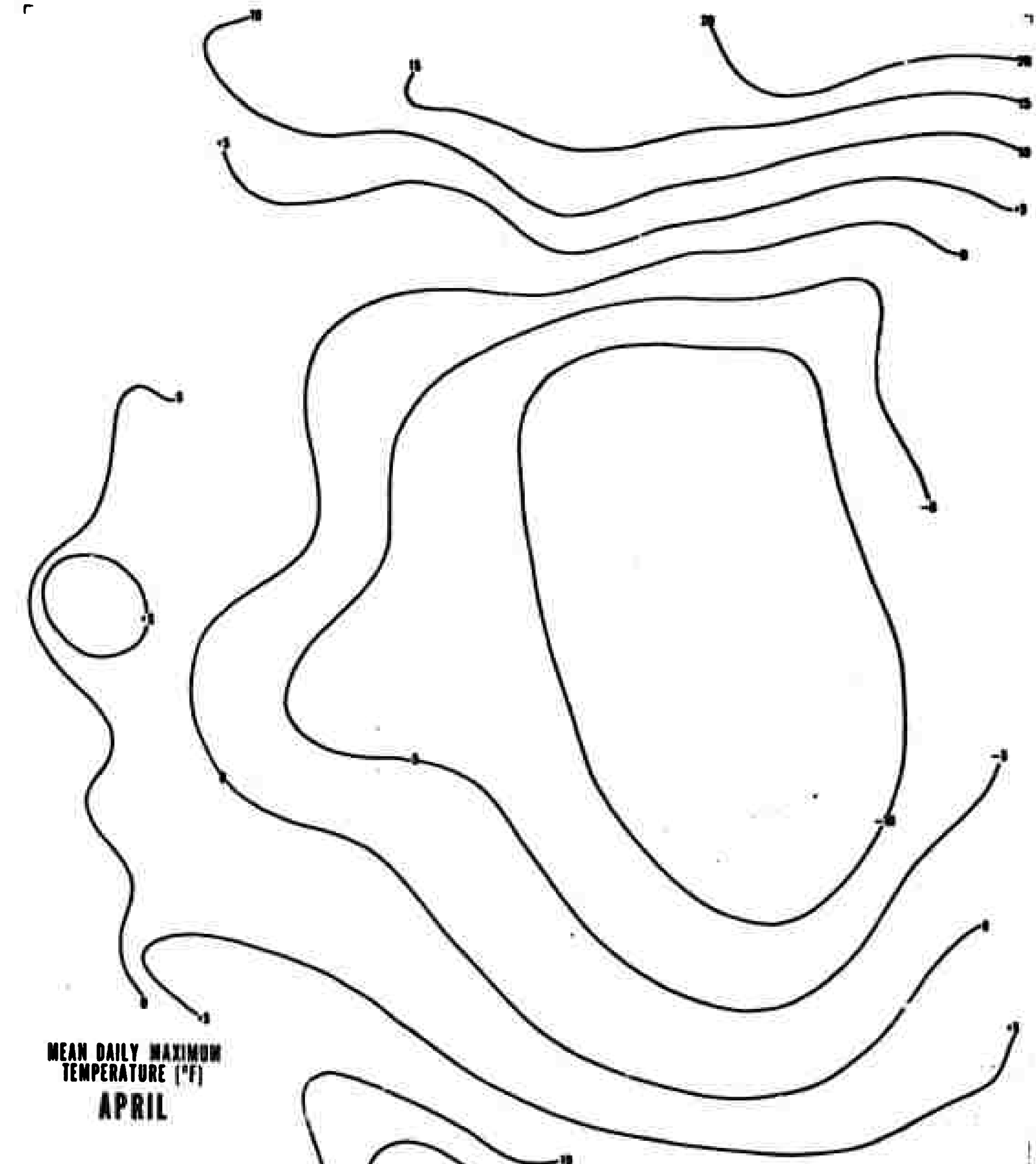

MEAN DAILY MAXIMUM
TEMPERATURE (°F)
JANUARY



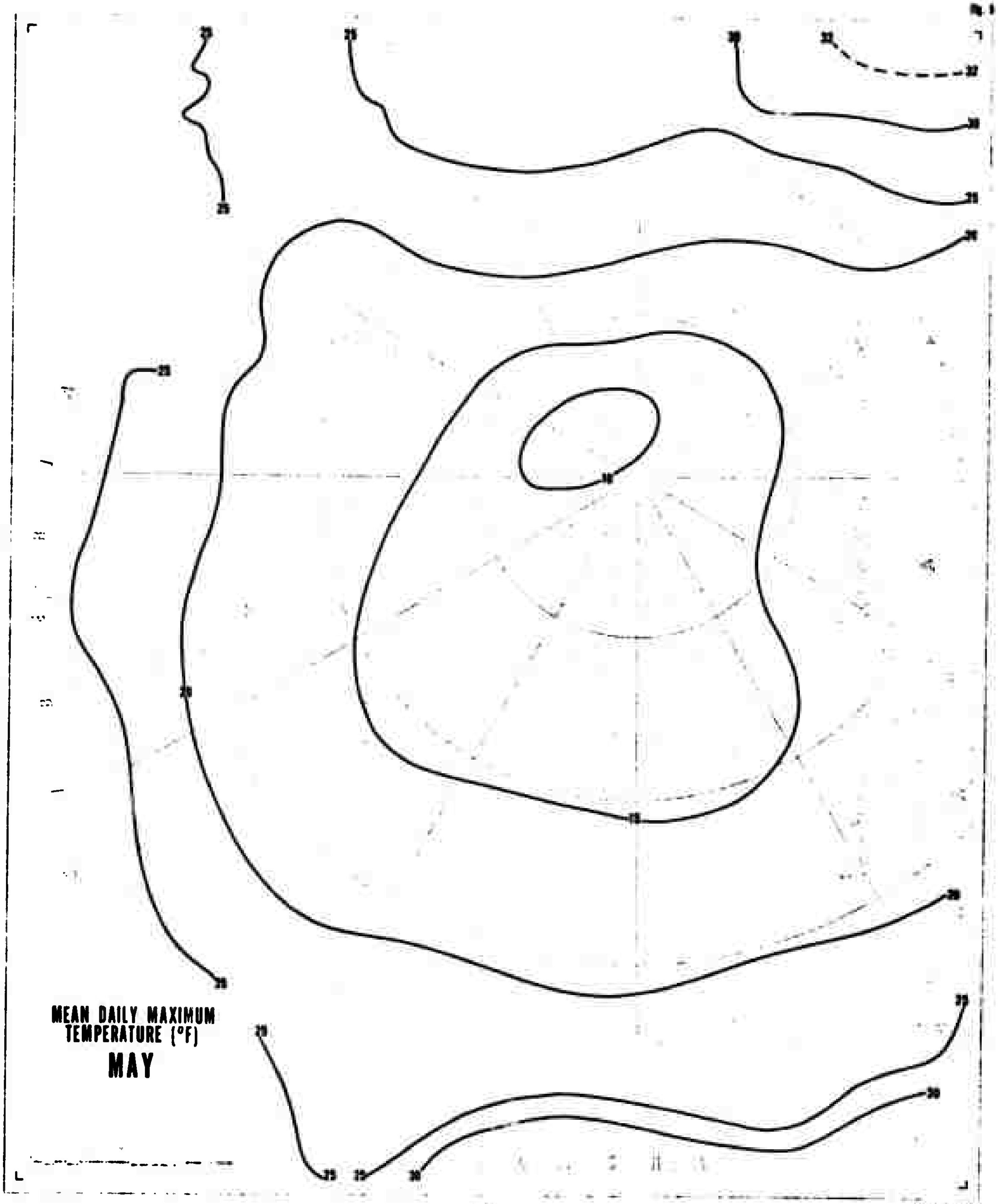
MEAN DAILY MAXIMUM TEMPERATURE (°F)

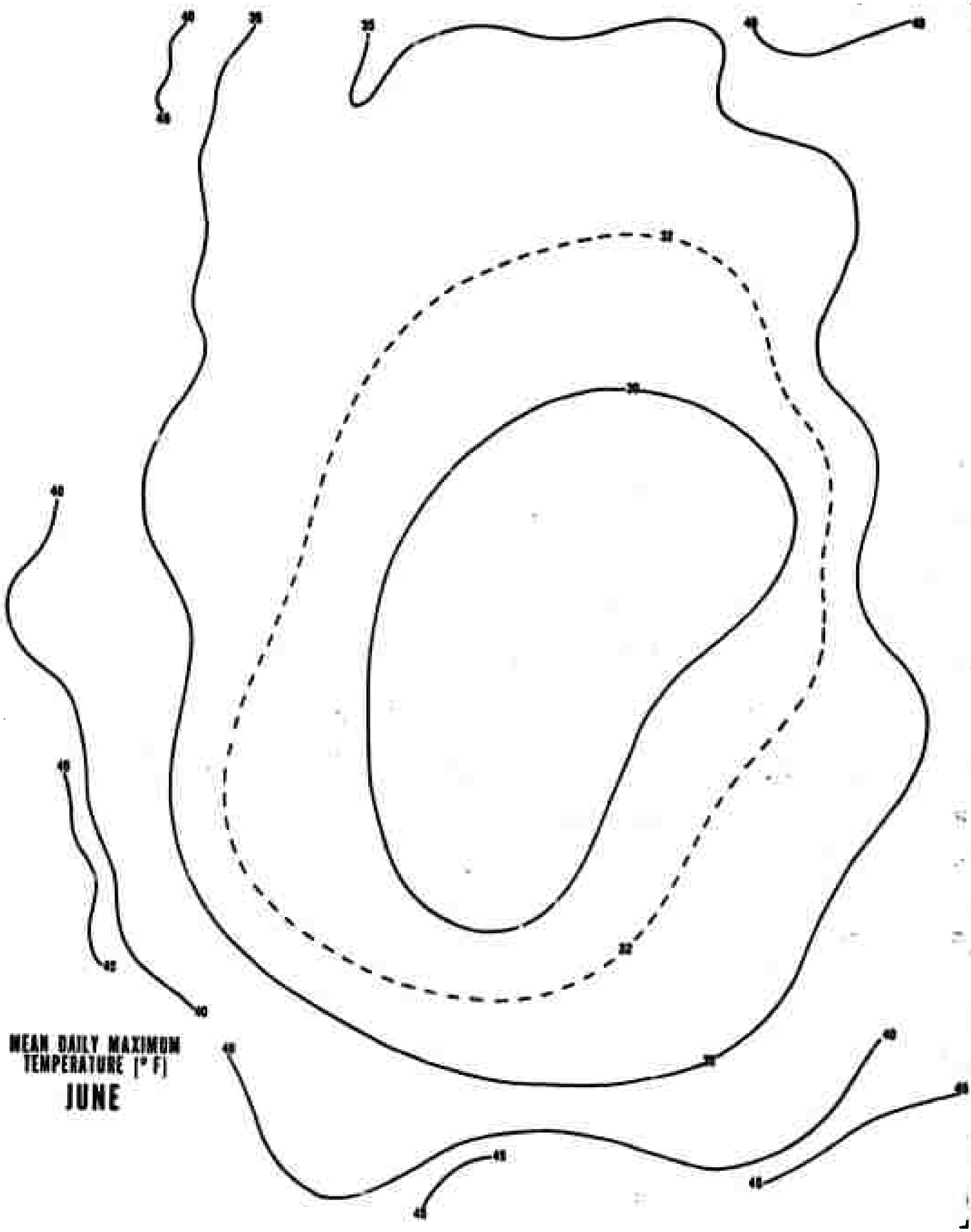
FEBRUARY


MEAN DAILY MAXIMUM
TEMPERATURE [°F]
MARCH
-10
-15
-20
-25
-30
-5
0
5
10
15



MEAN DAILY MAXIMUM TEMPERATURE (°F)
APRIL


MEAN DAILY MAXIMUM
TEMPERATURE (°F)
MAY



MEAN DAILY MAXIMUM TEMPERATURE (° F)

JUNE

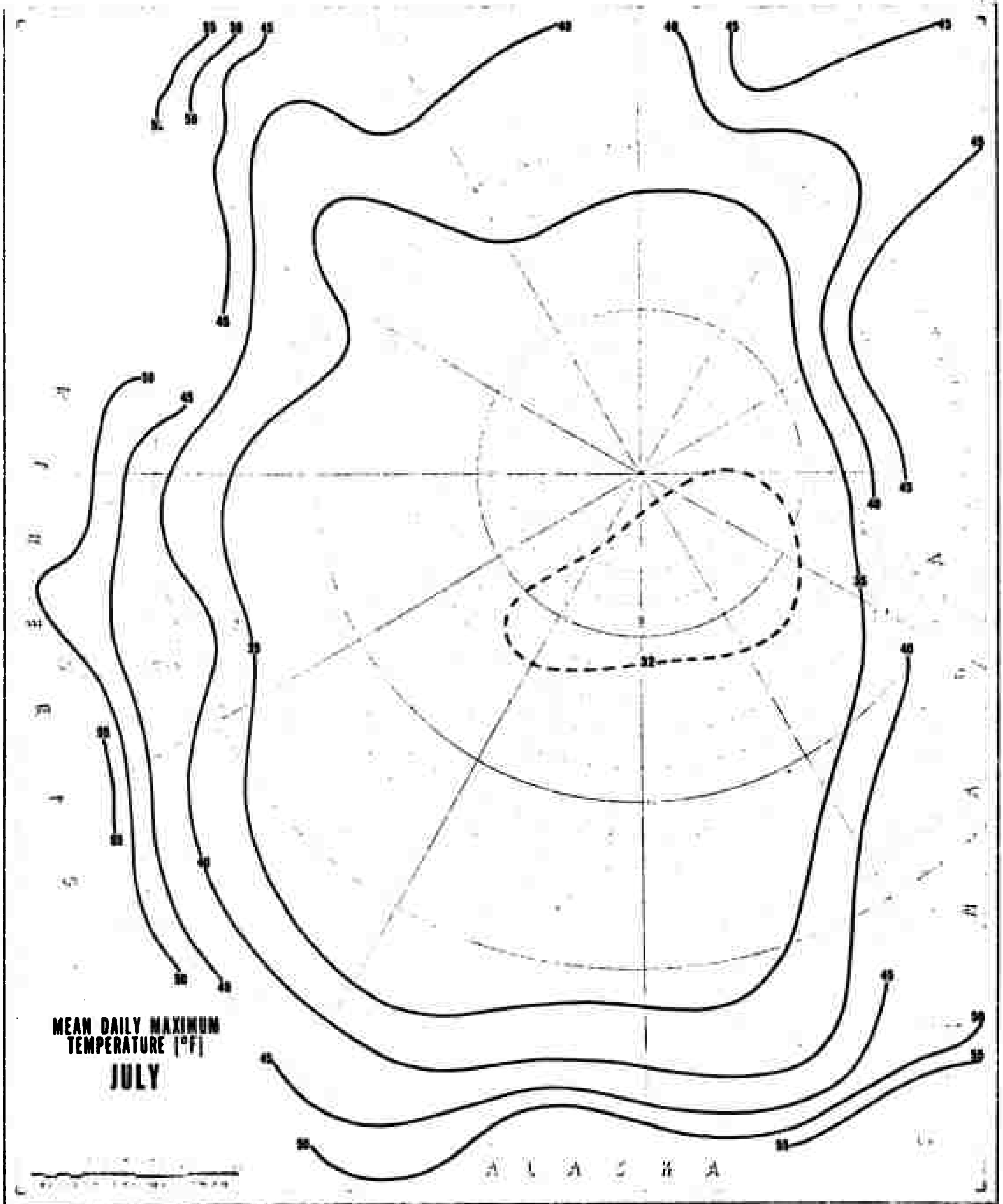
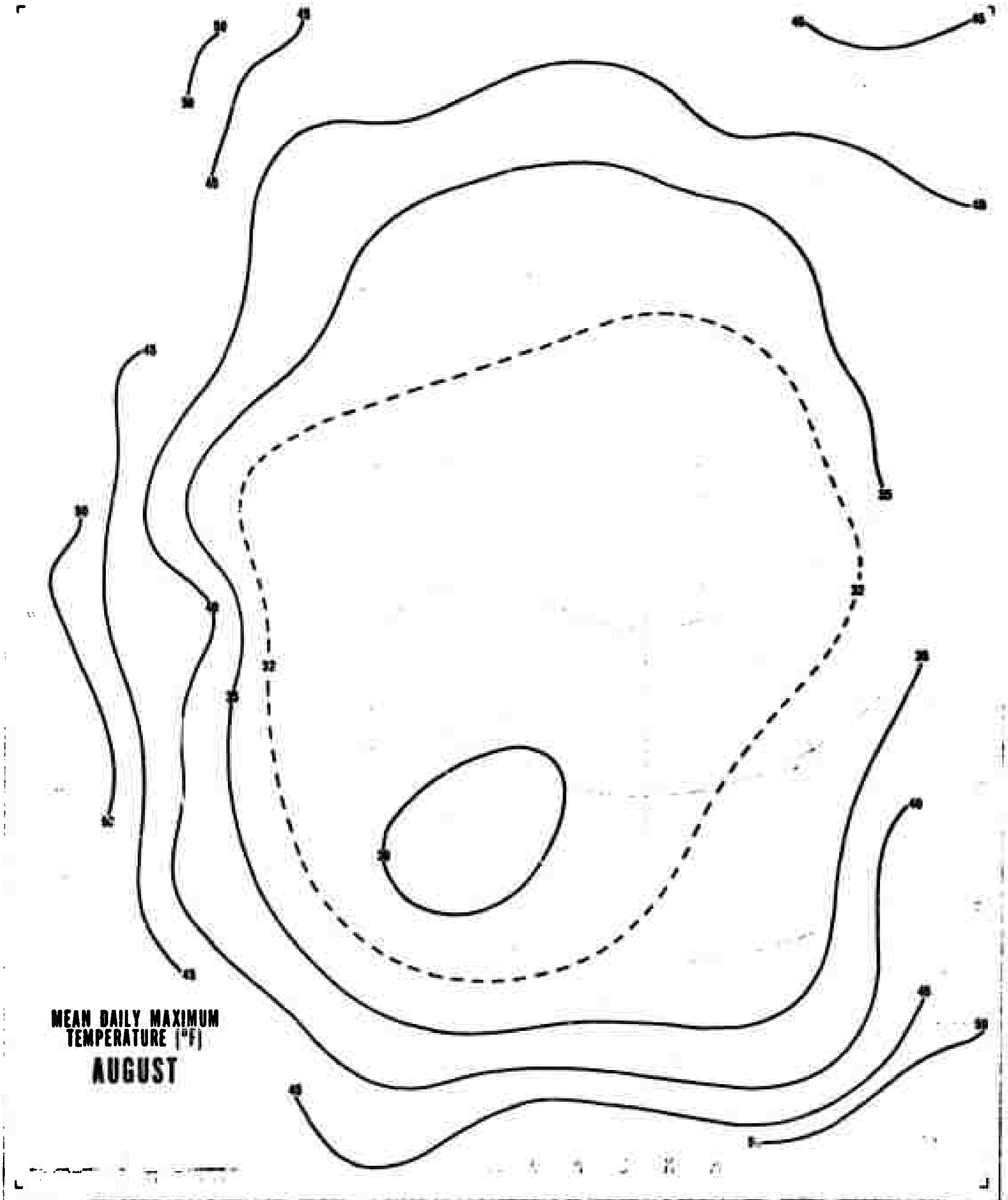
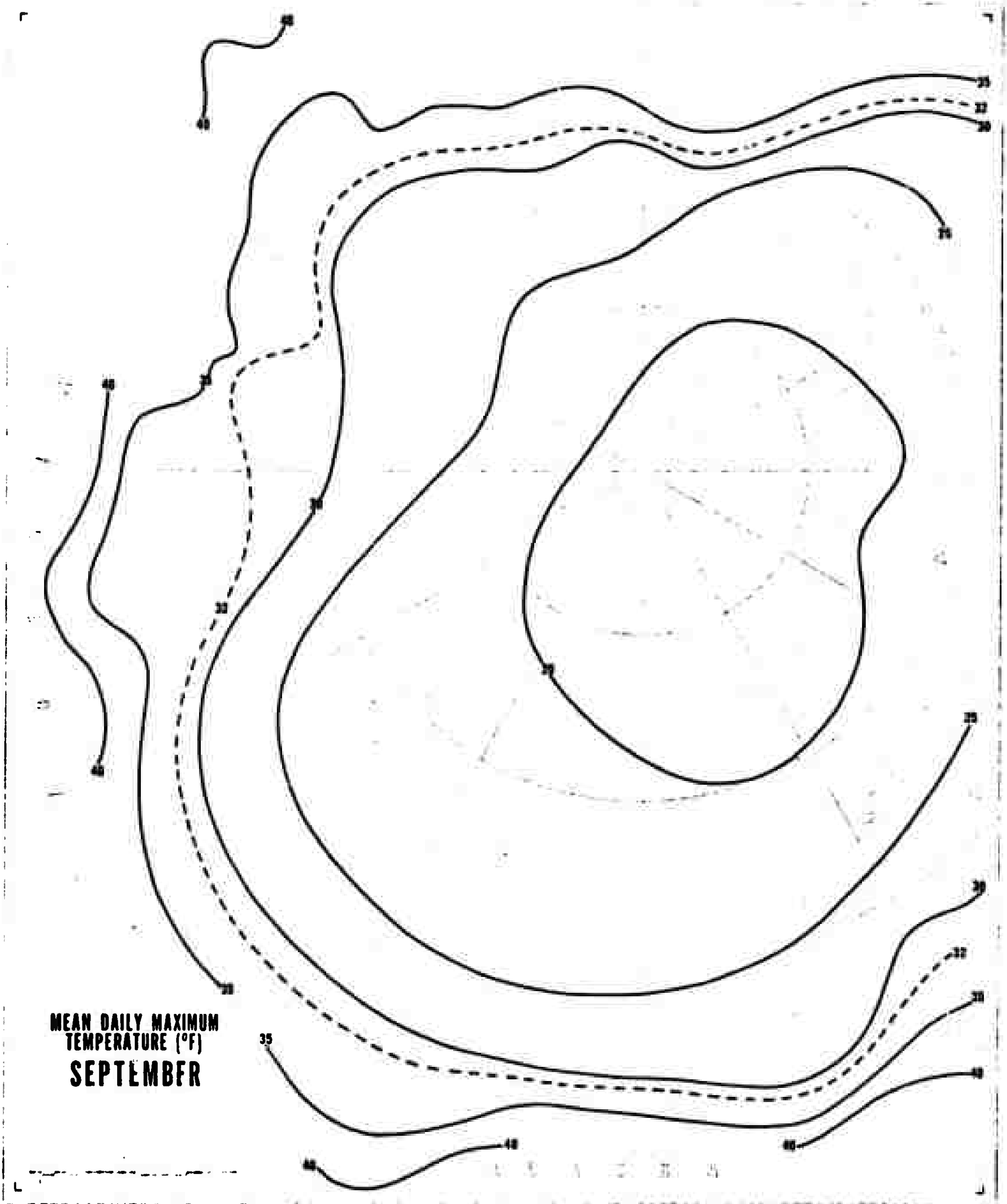

MEAN DAILY MAXIMUM
TEMPERATURE (°F)
JULY
ALASKA
32
35
40
45
50
55
60

Fig. 8

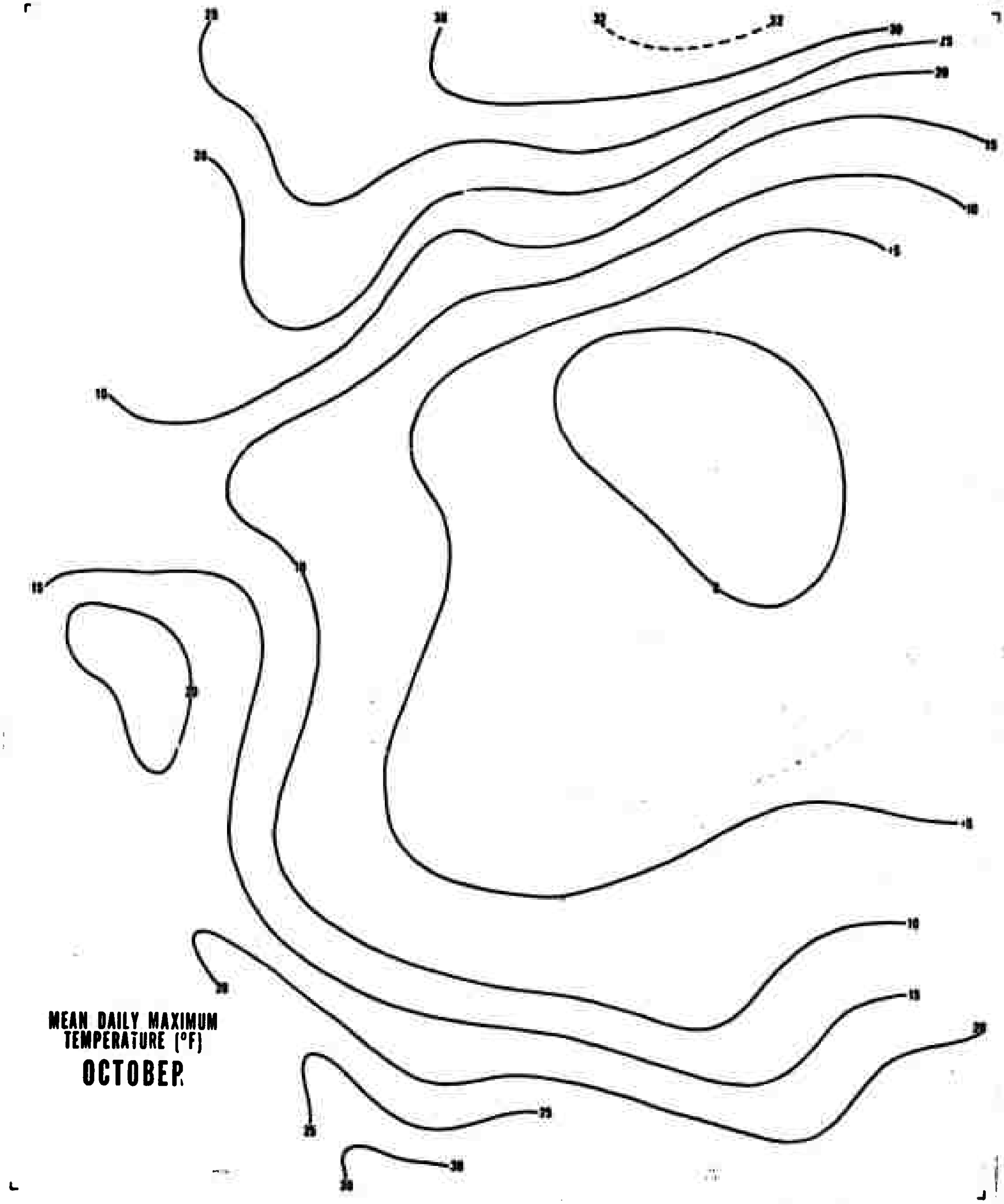




MEAN DAILY MAXIMUM TEMPERATURE (°F)

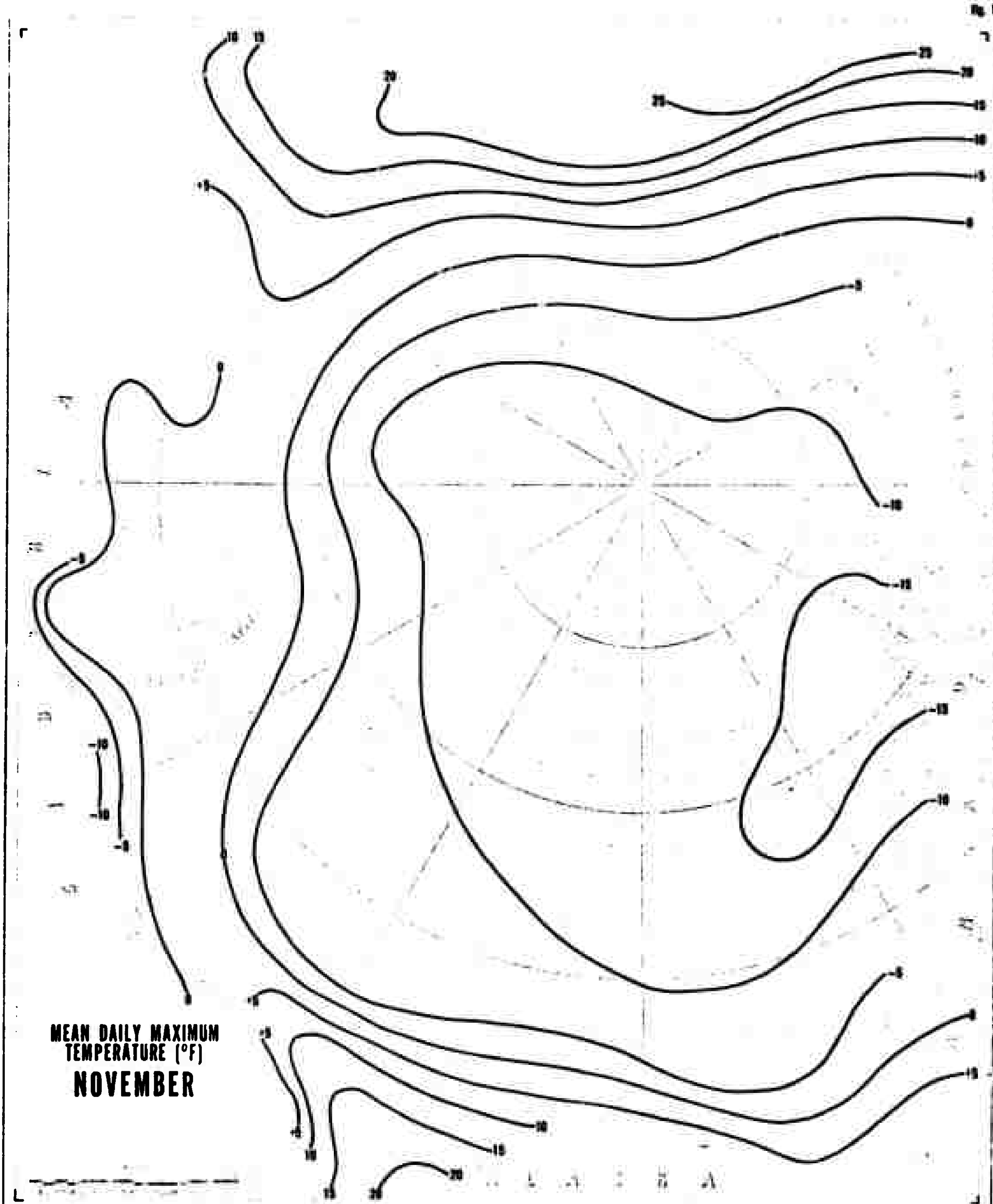
SEPTEMBER

Fig. 11



MEAN DAILY MAXIMUM
TEMPERATURE (°F)
OCTOBER

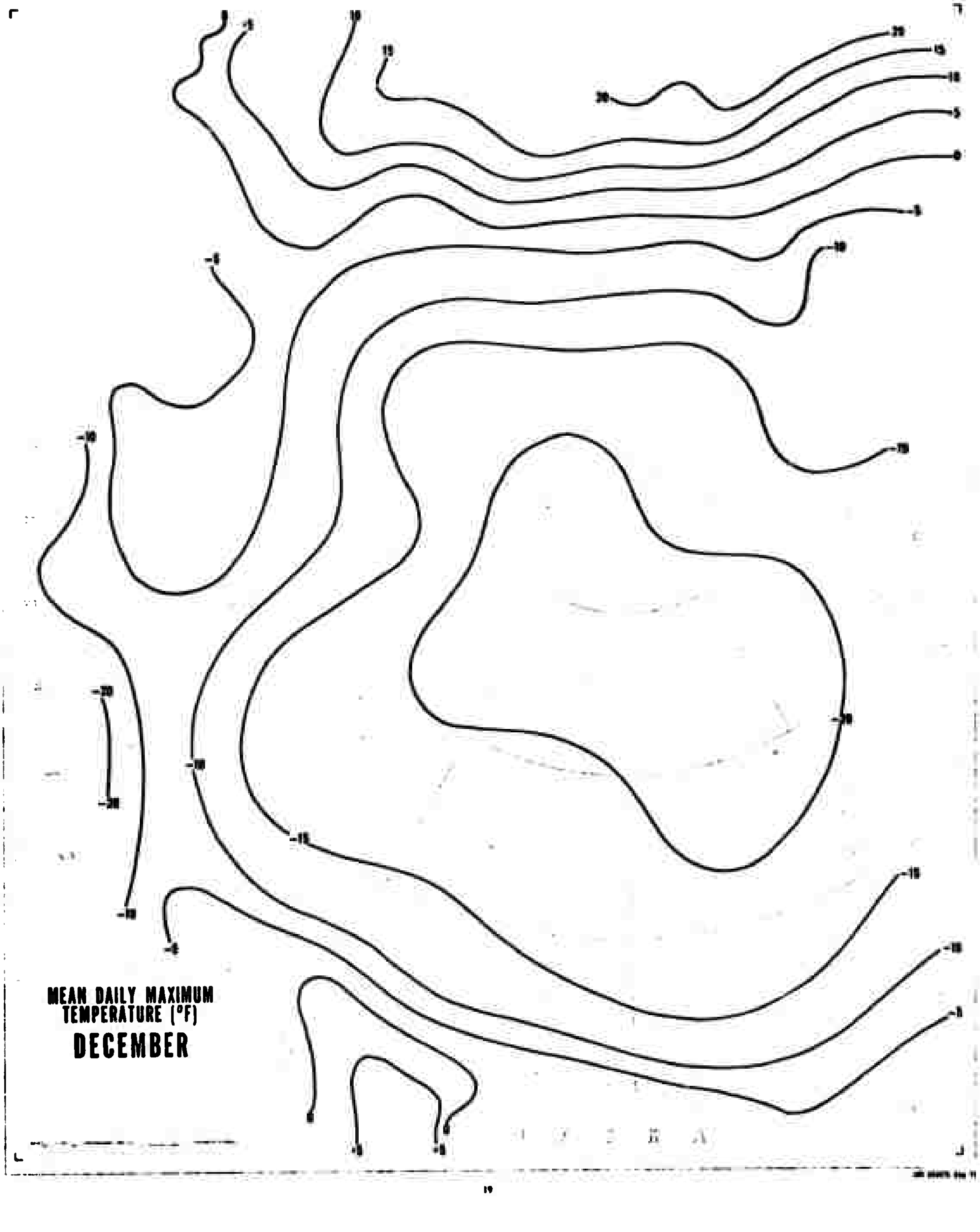
Fig. 11

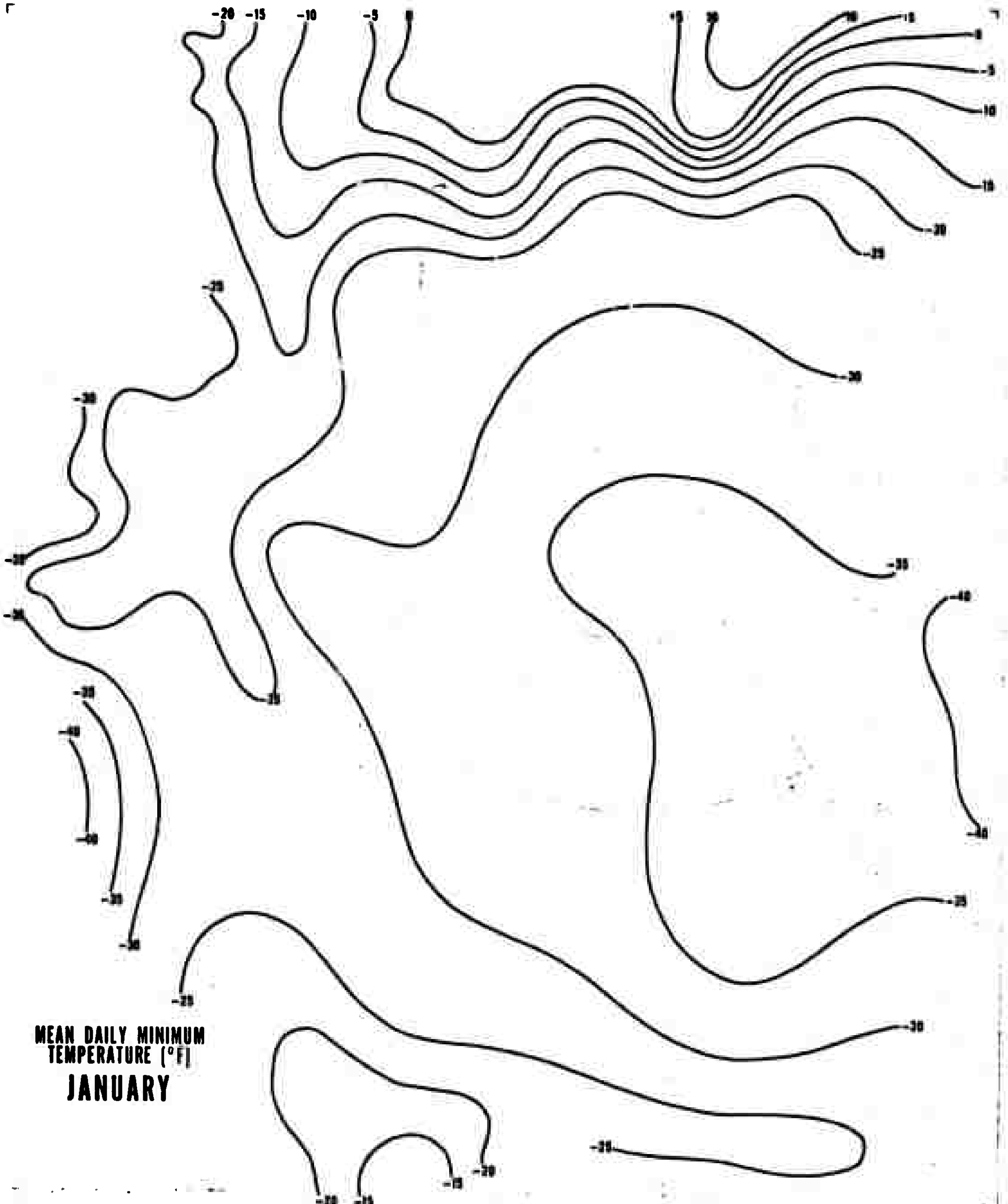


MEAN DAILY MAXIMUM TEMPERATURE (°F)
NOVEMBER

ETAC USAFETAC Sep 71

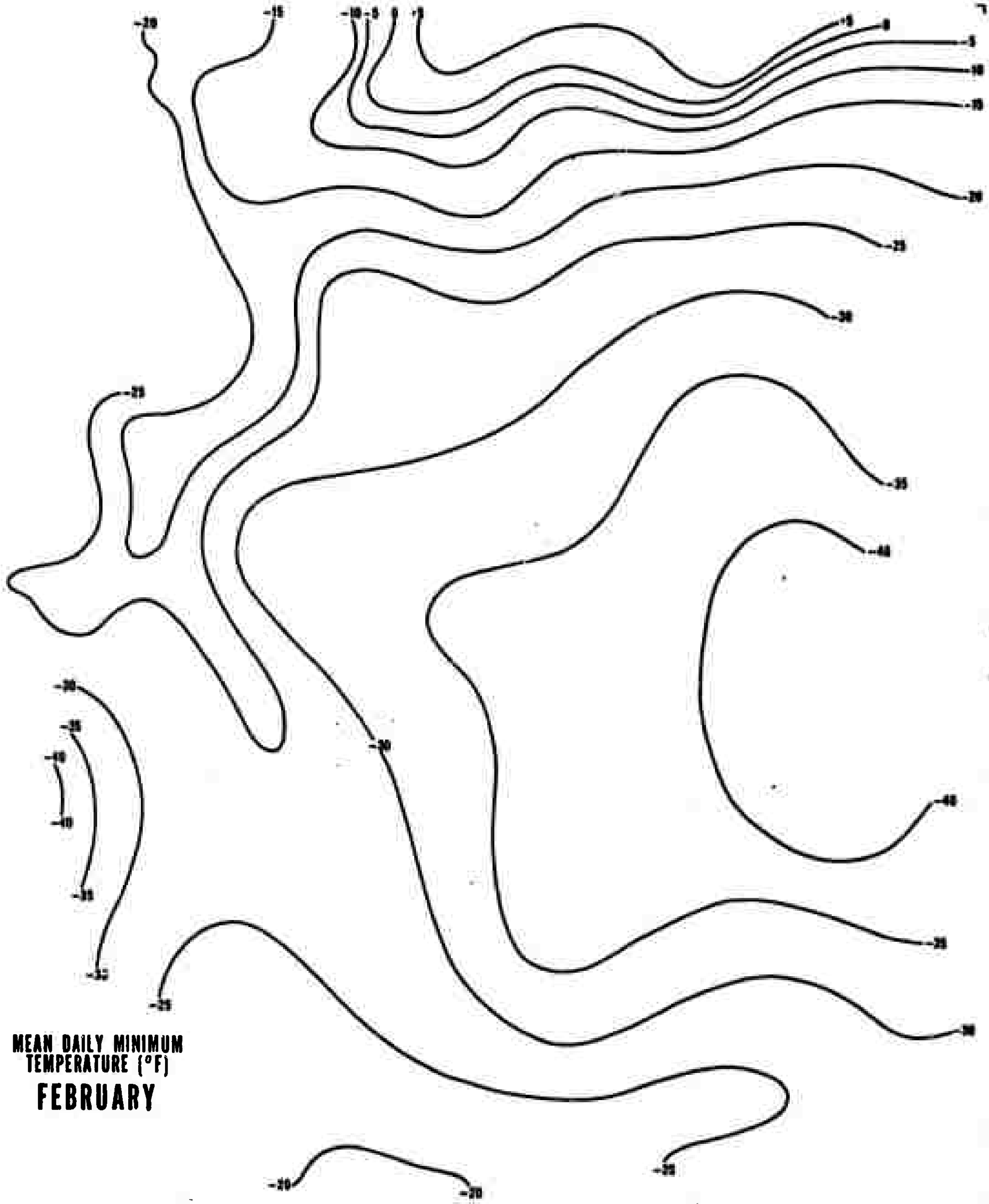
Fig. 13





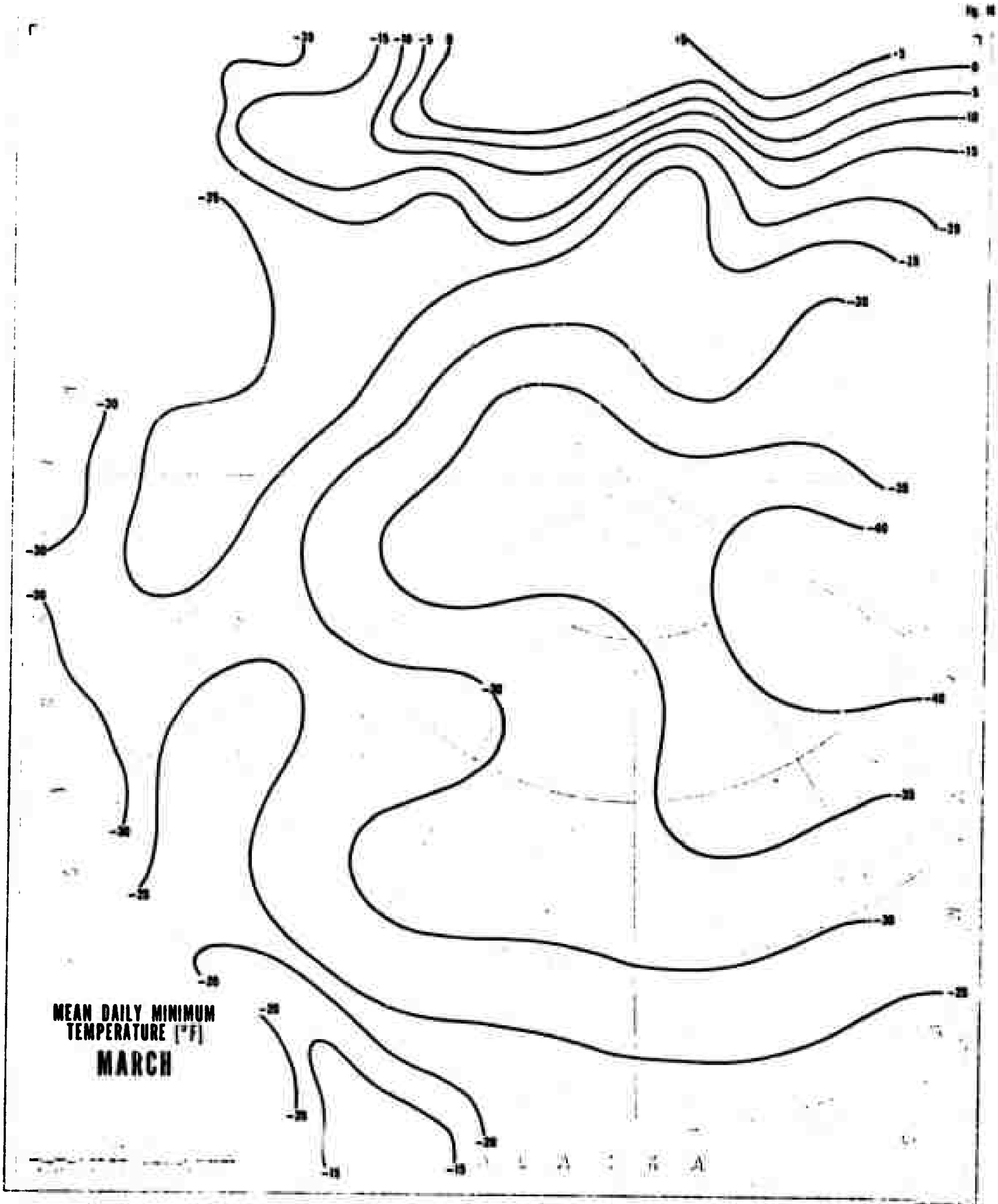
MEAN DAILY MINIMUM TEMPERATURE (°F)

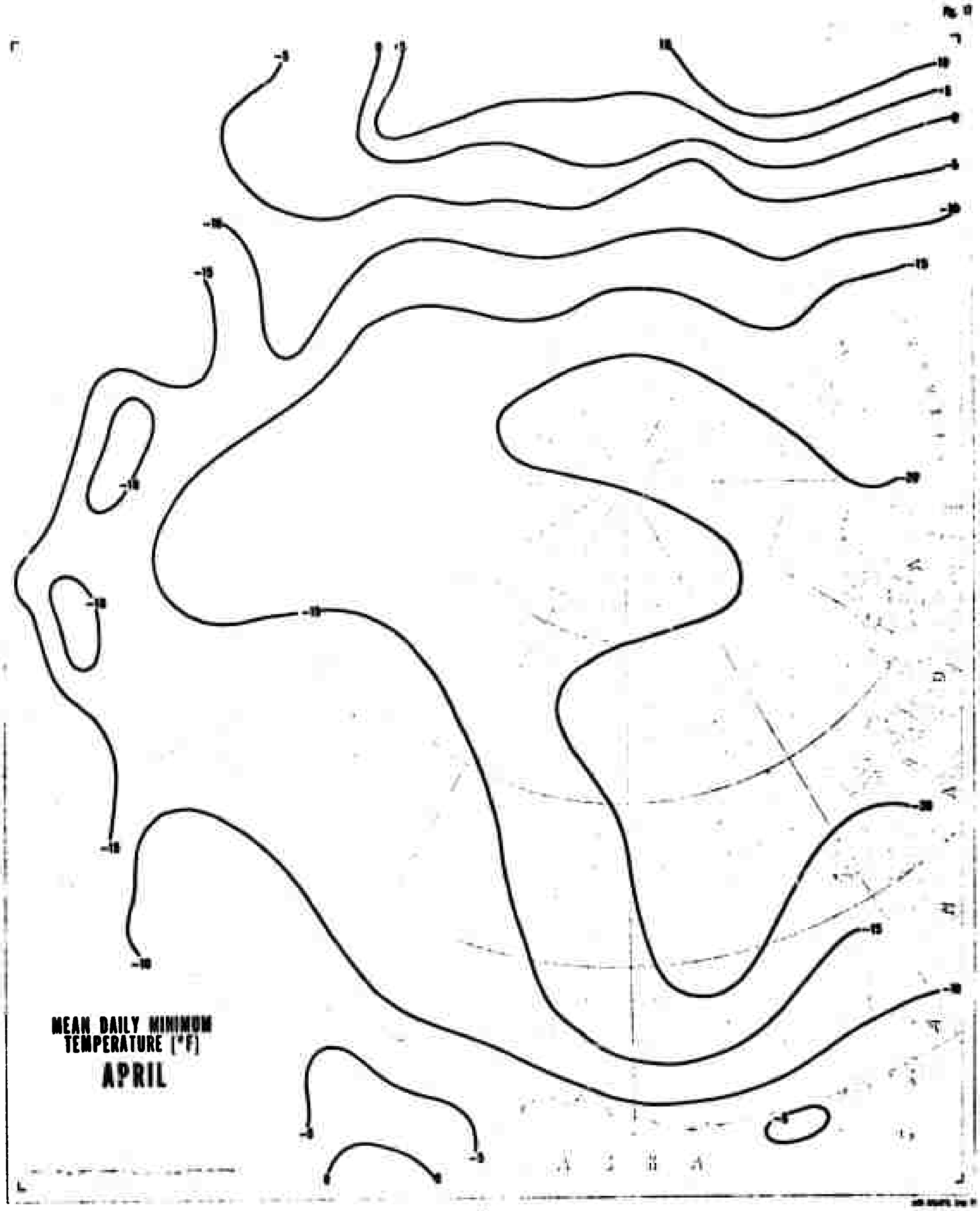
JANUARY



MEAN DAILY MINIMUM
TEMPERATURE (°F)

FEBRUARY


MEAN DAILY MINIMUM
TEMPERATURE (°F)
MARCH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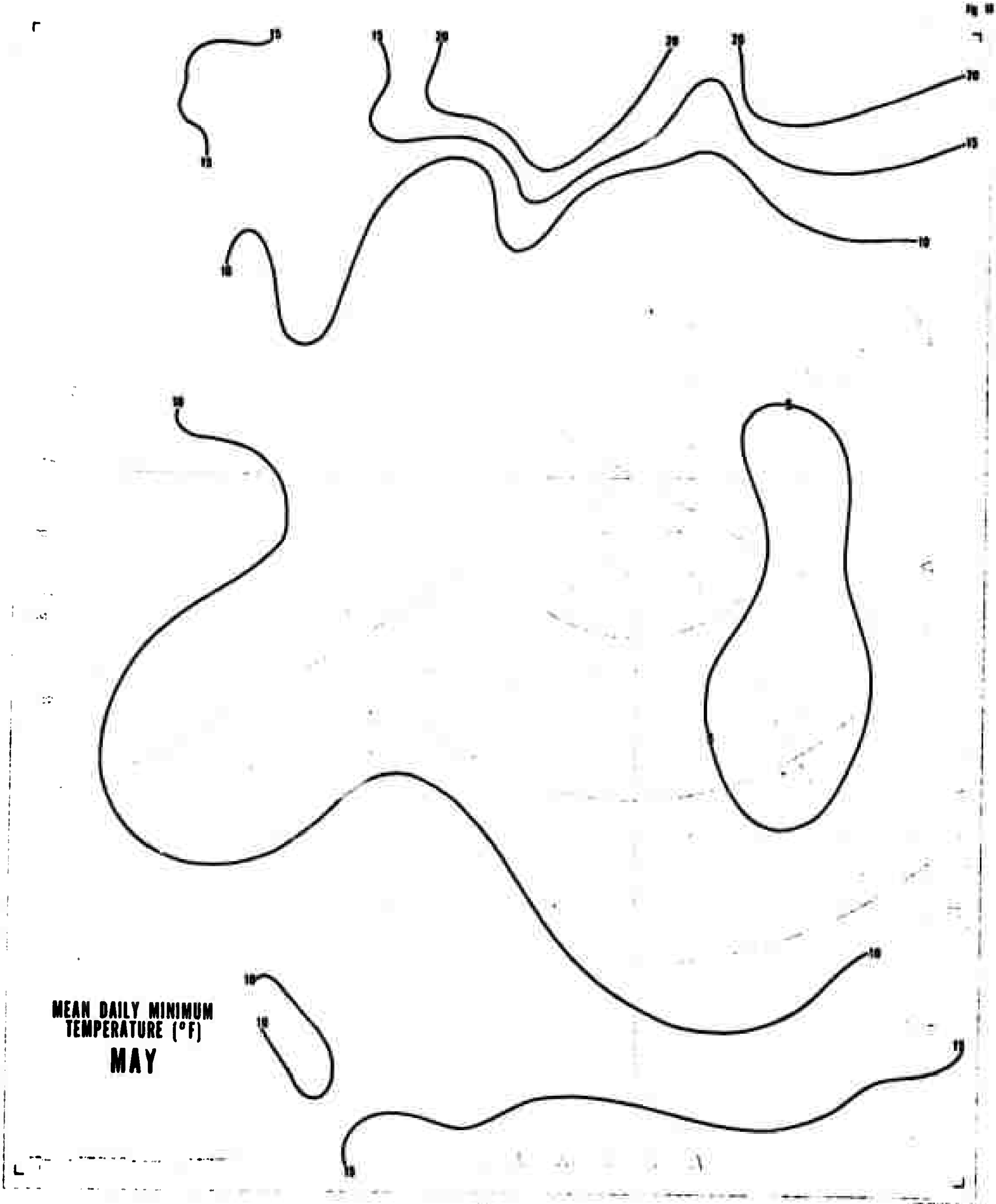
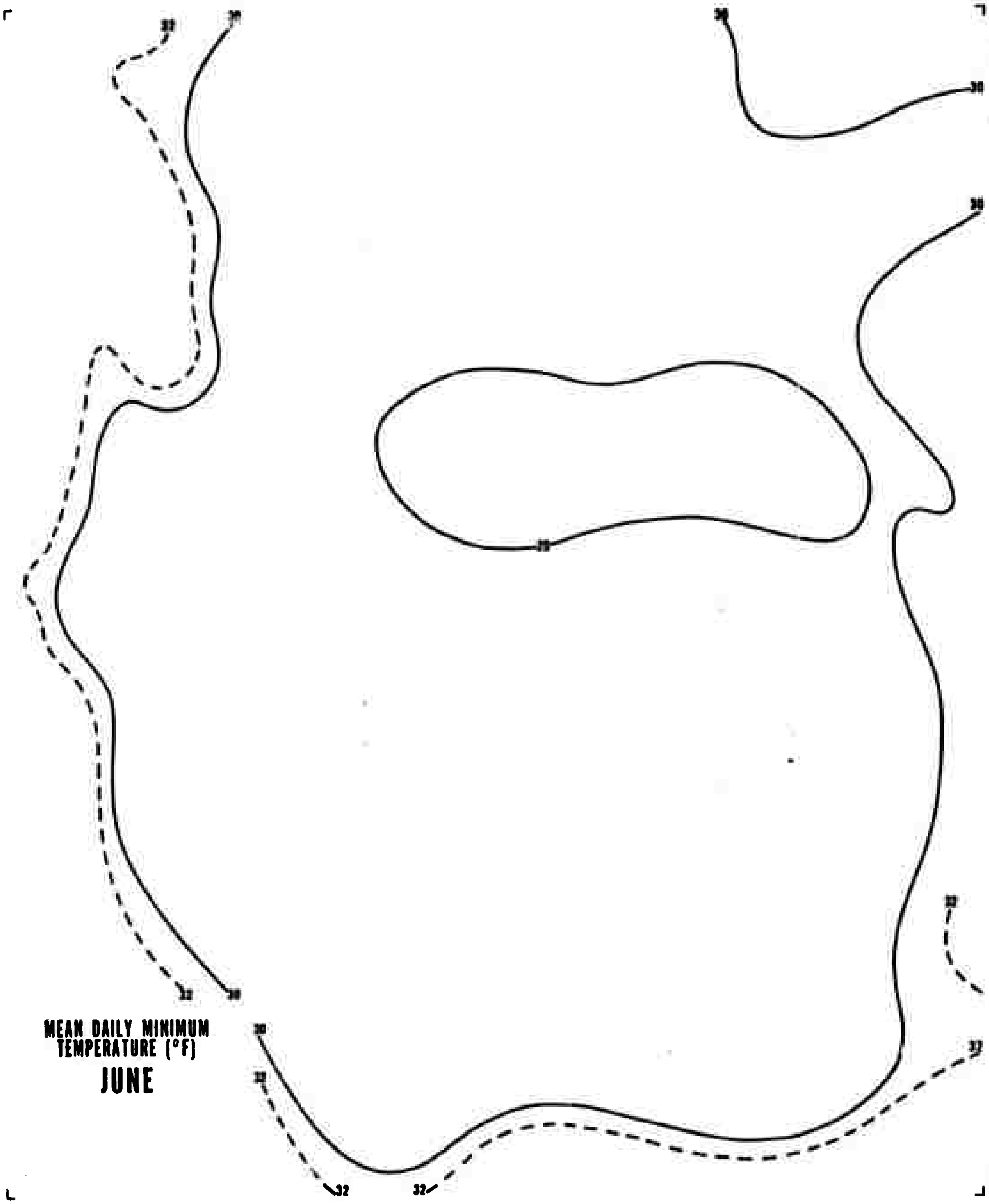
TEMPERATURE (°F)
APRIL

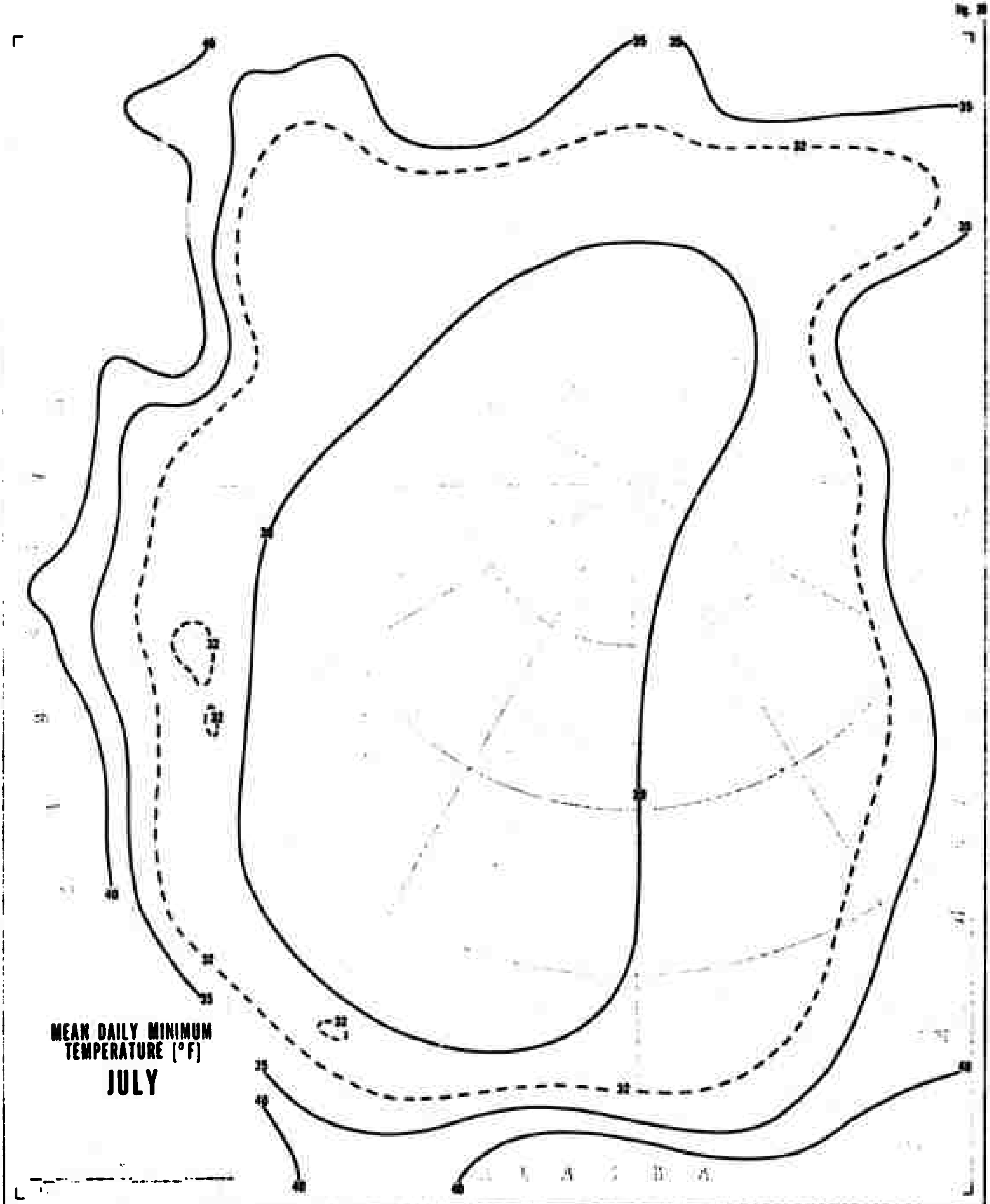


MEAN DAILY MINIMUM TEMPERATURE (°F)

MAY



MEAN DAILY MINIMUM TEMPERATURE (°F)
JUNE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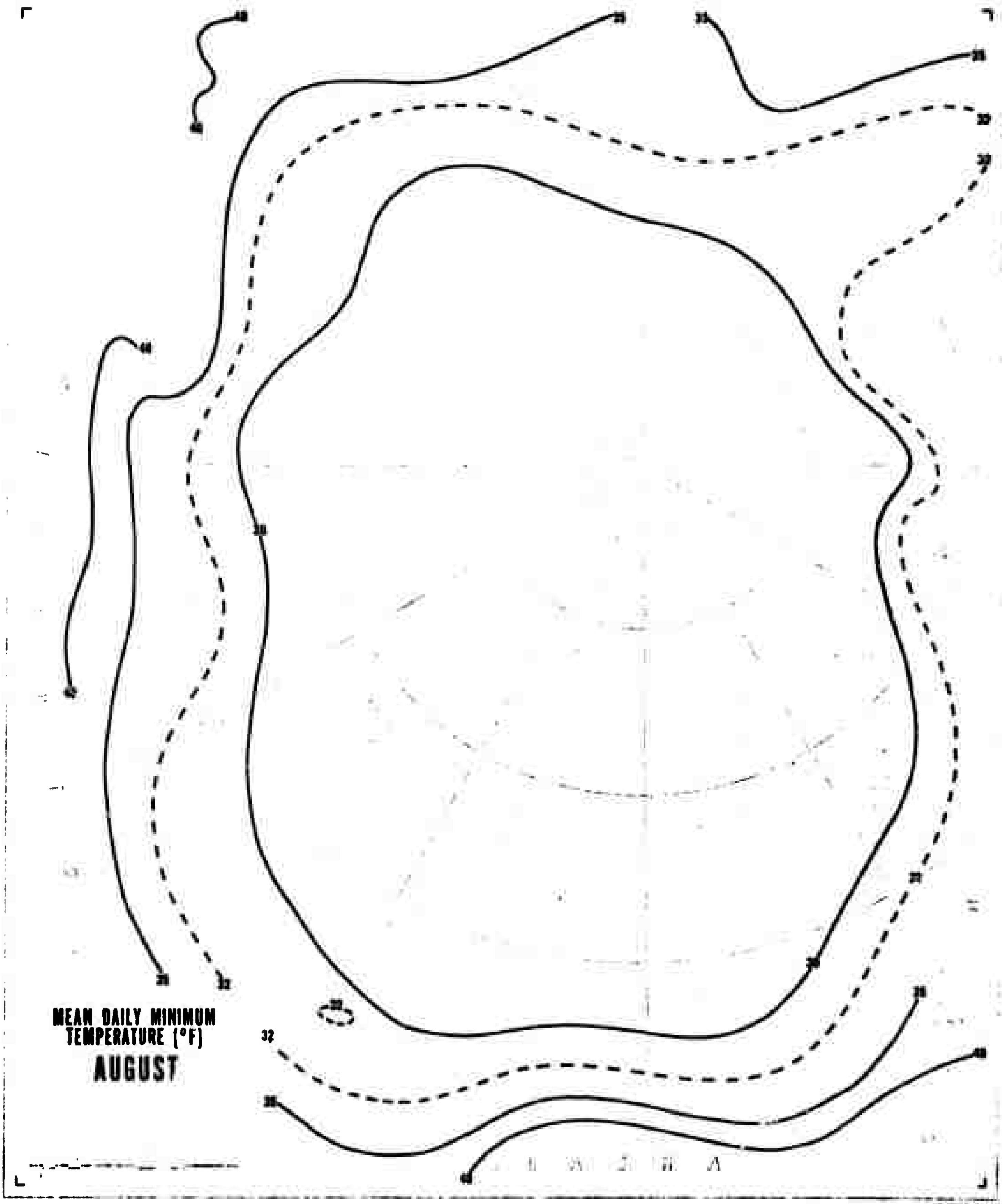
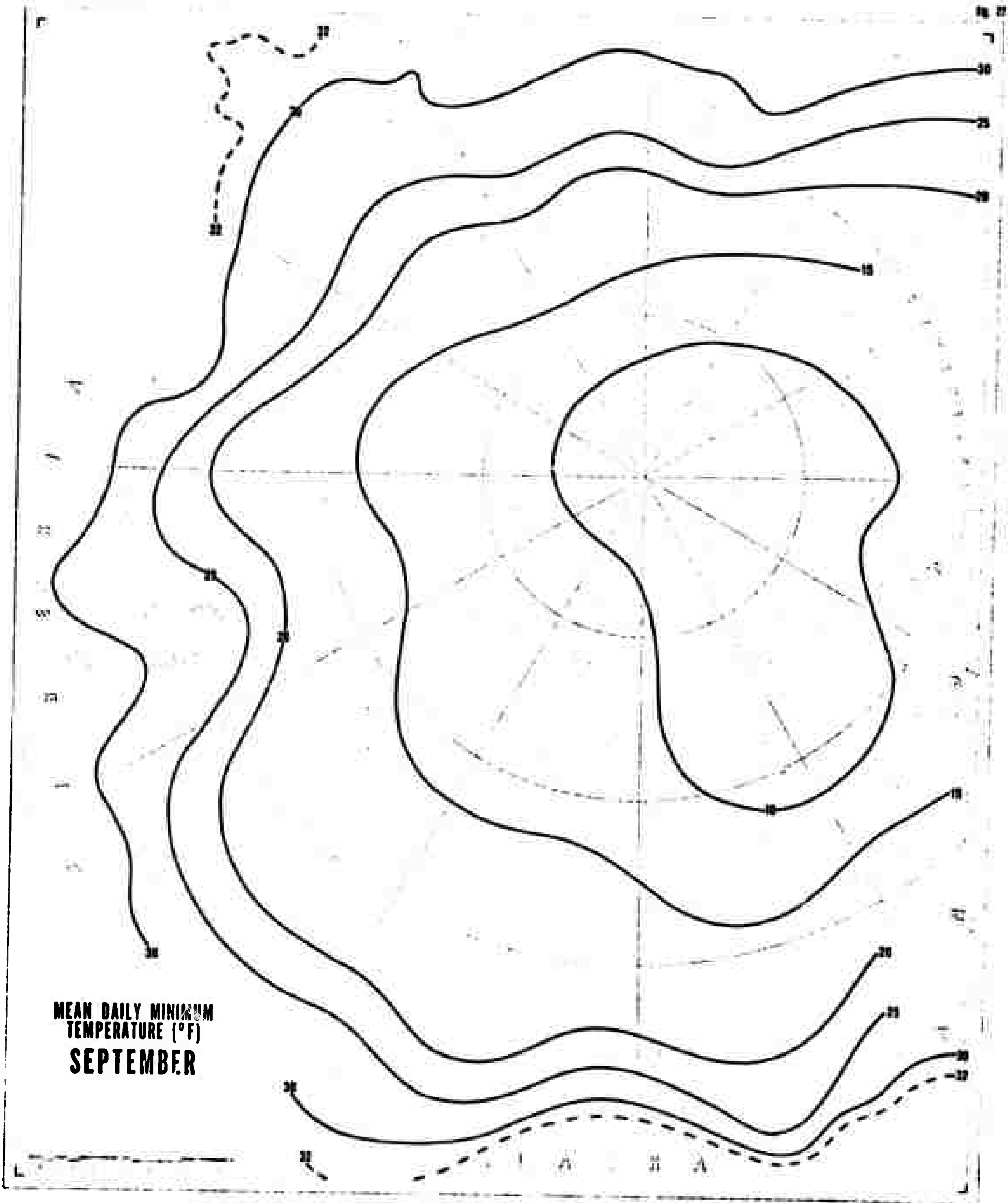
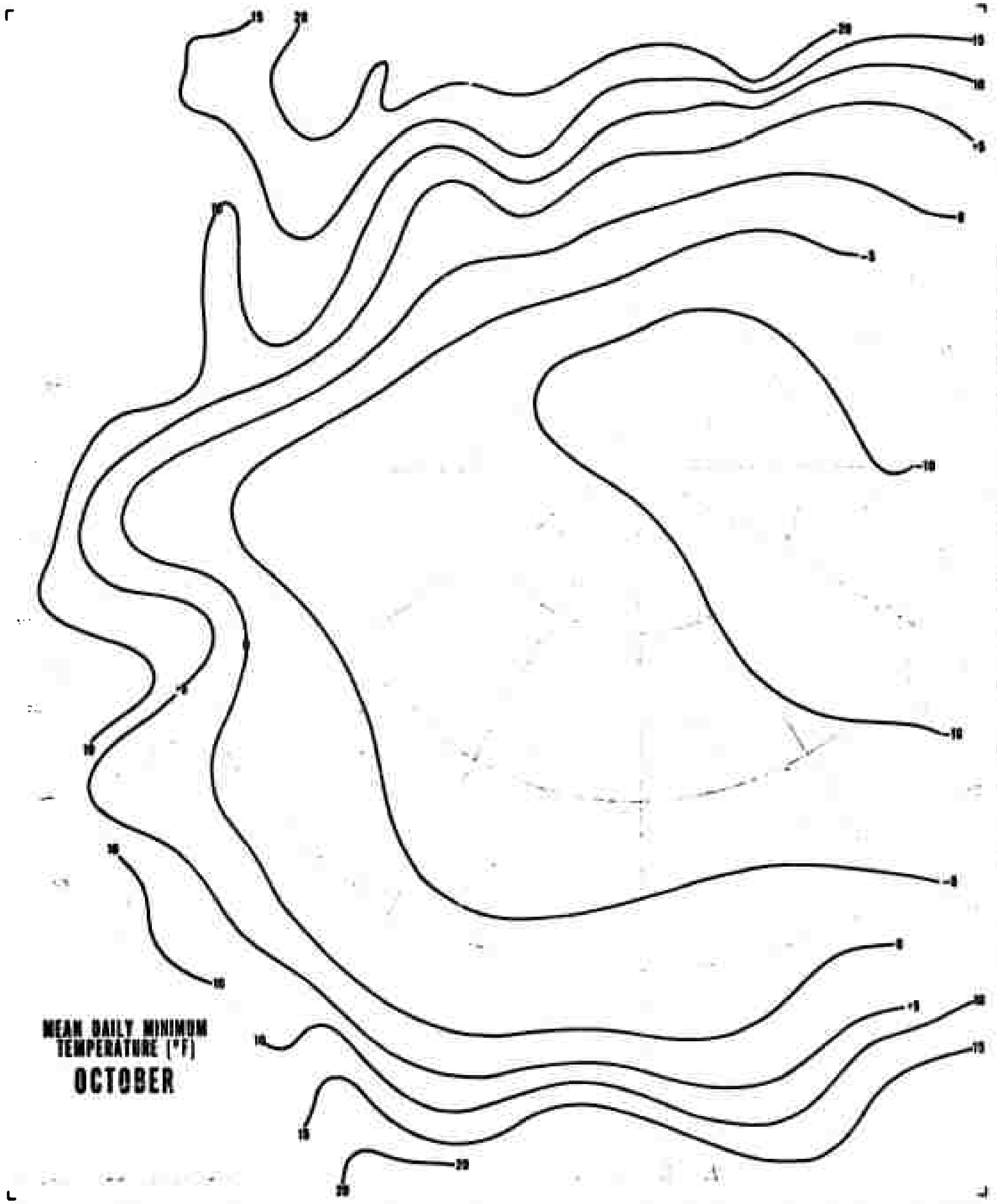
TEMPERATURE (°F)
JULY

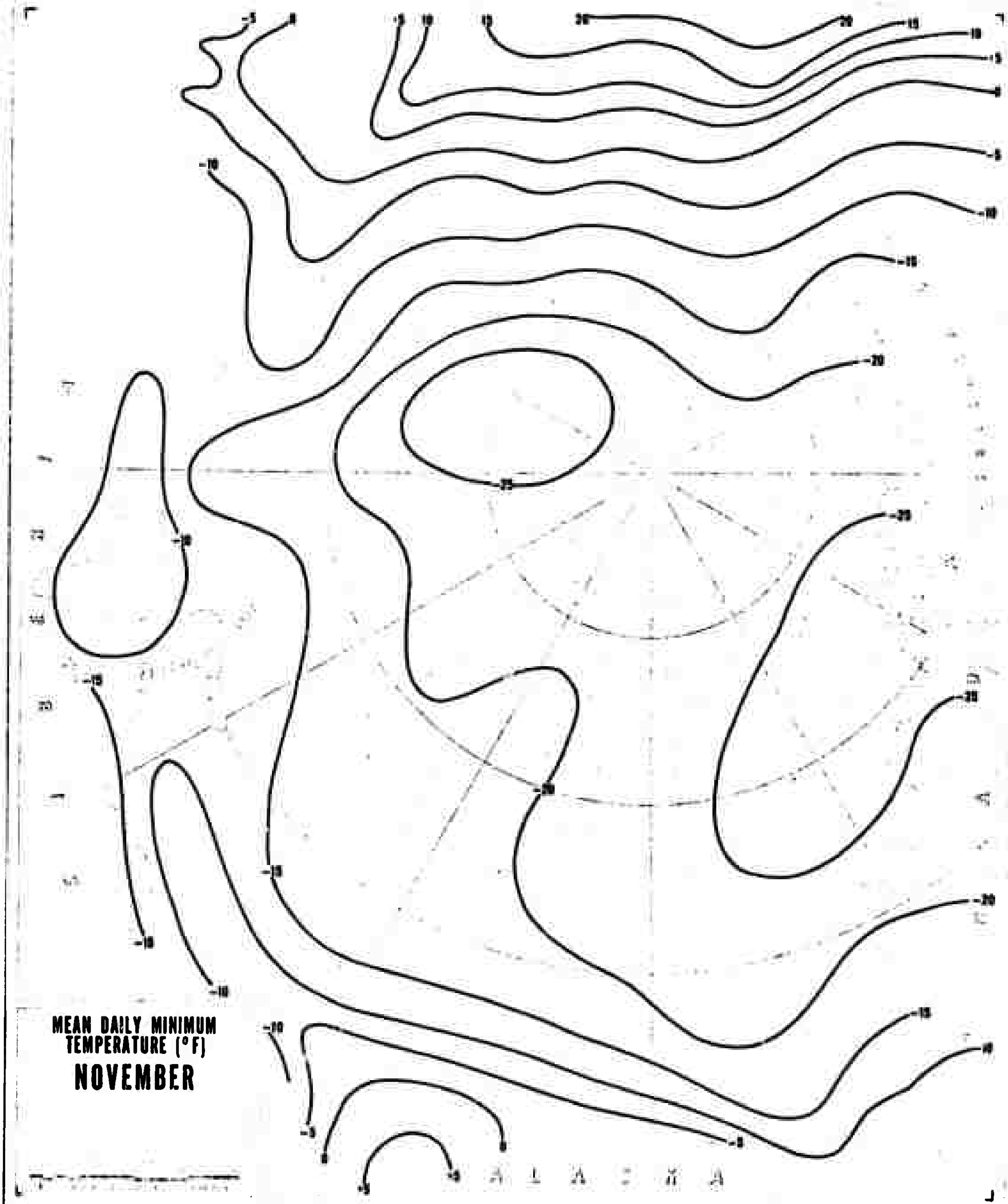

MEAN DAILY MINIMUM
TEMPERATURE (°F)
AUGUST
40
35
32


MEAN DAILY MINIMUM
TEMPERATURE (°F)
SEPTEMBER
32
30
25
20
15
10



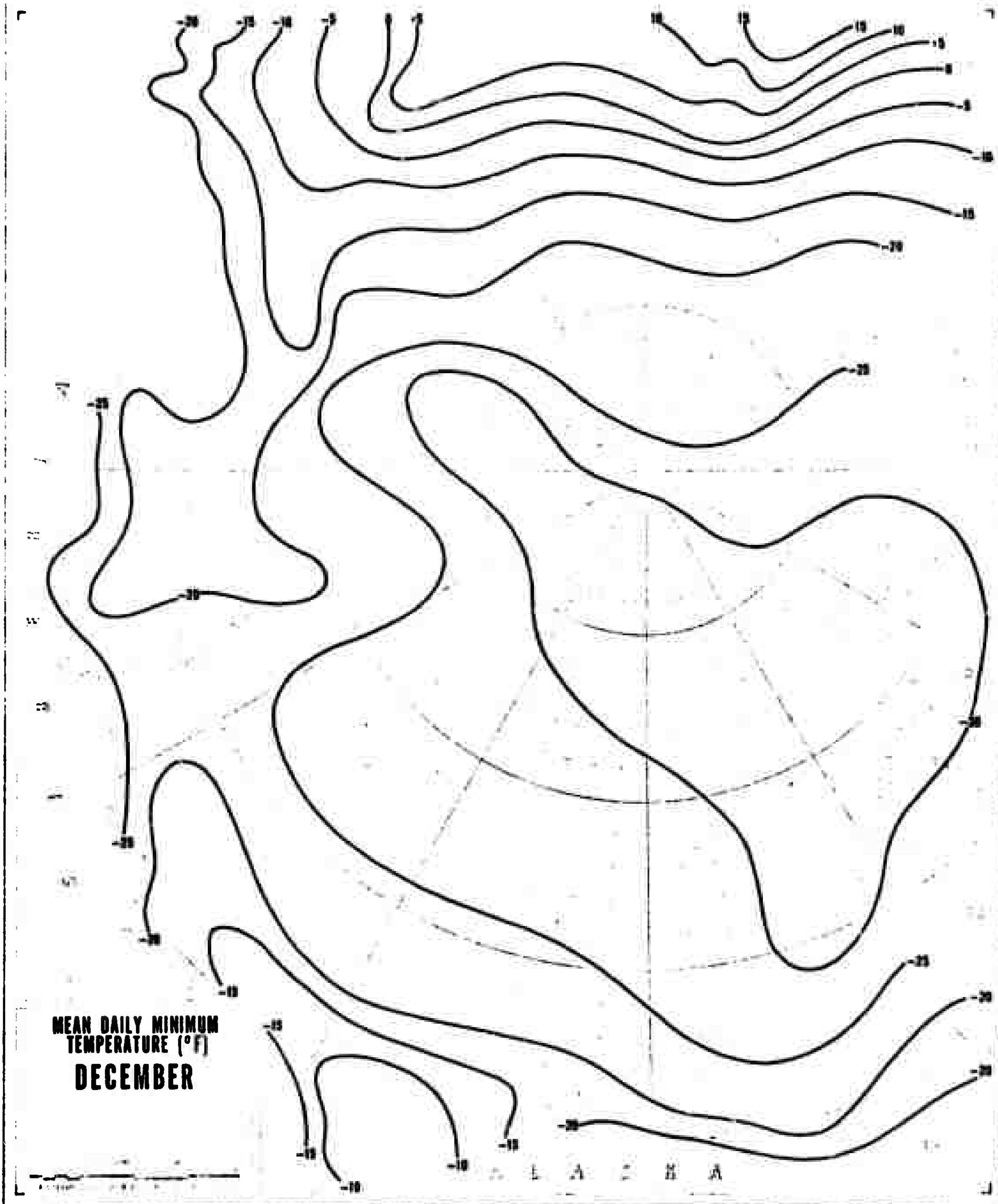
MEAN DAILY MINIMUM TEMPERATURE (°F)

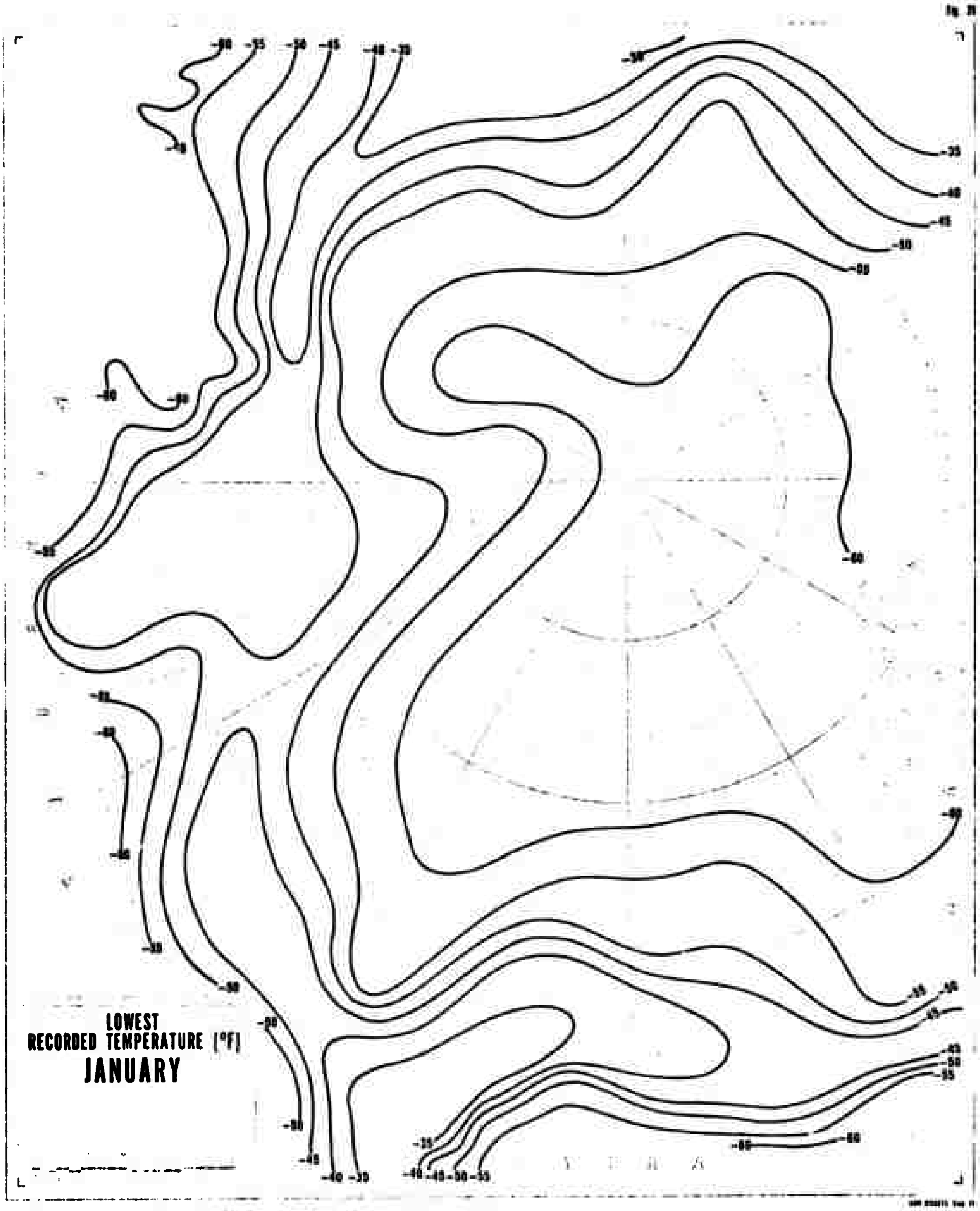
OCTOBER



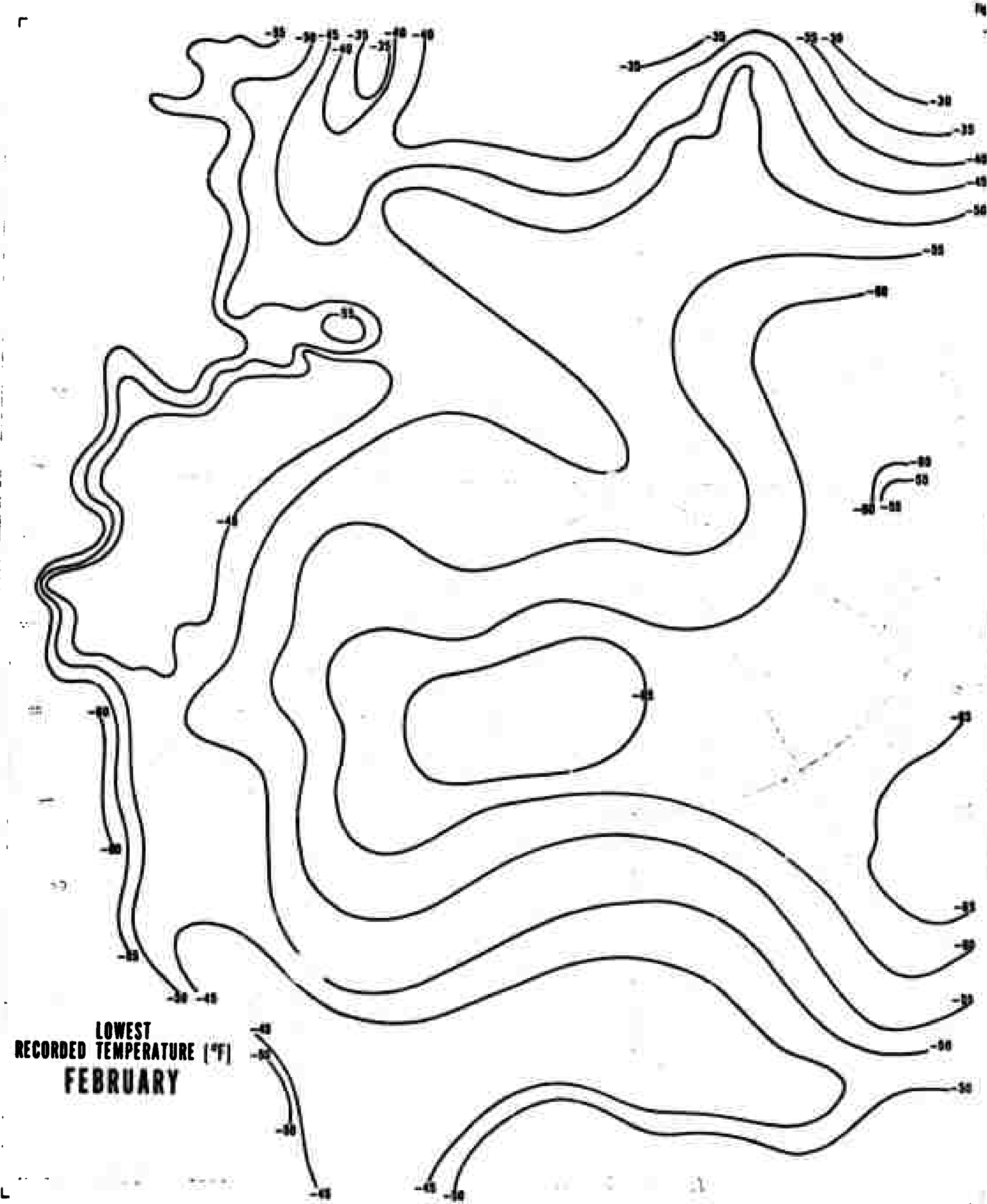
MEAN DAILY MINIMUM TEMPERATURE (°F)
NOVEMBER

669 USAETL Sep 71

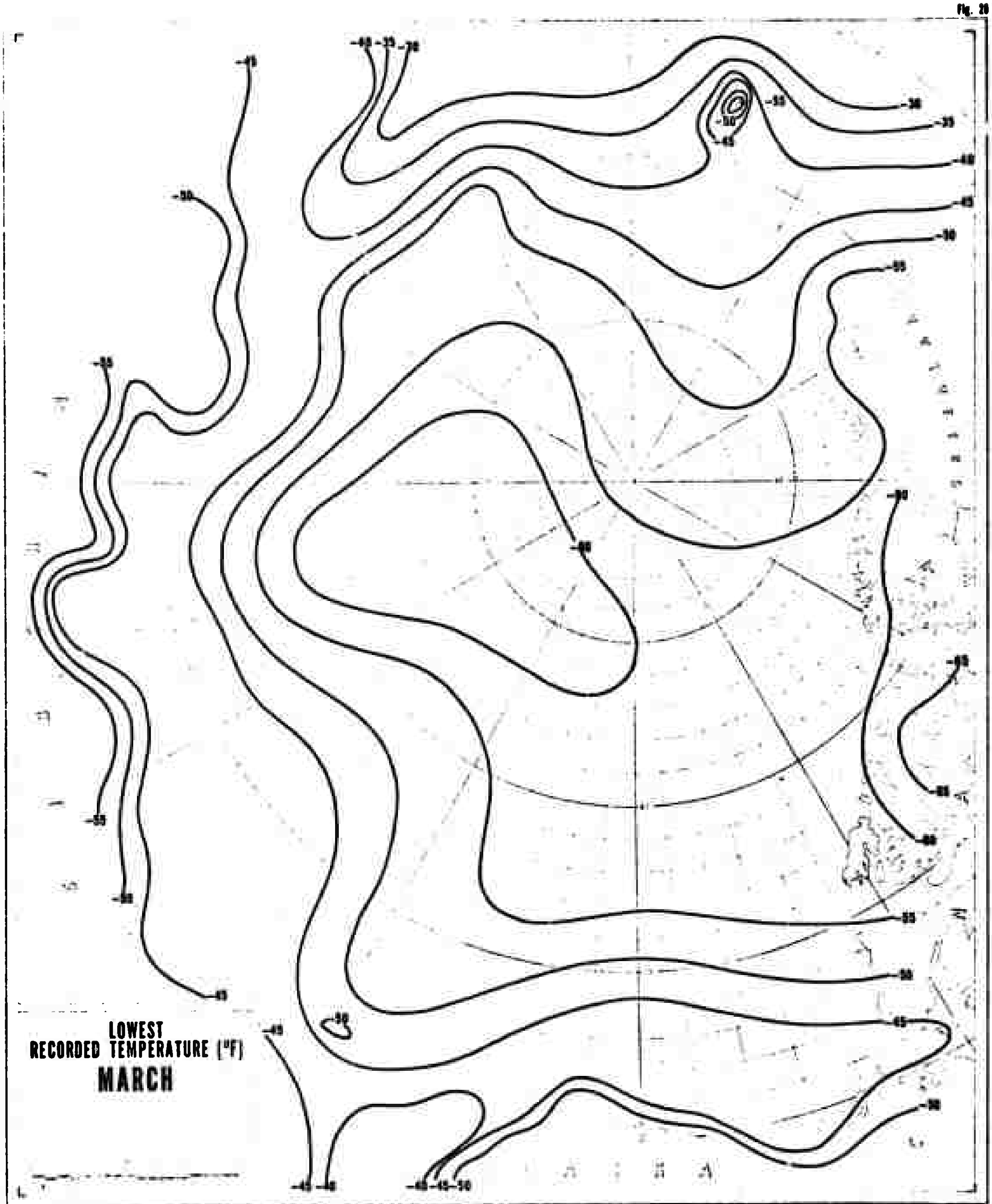

MEAN DAILY MINIMUM TEMPERATURE (°F)
DECEMBER
A L A S K A

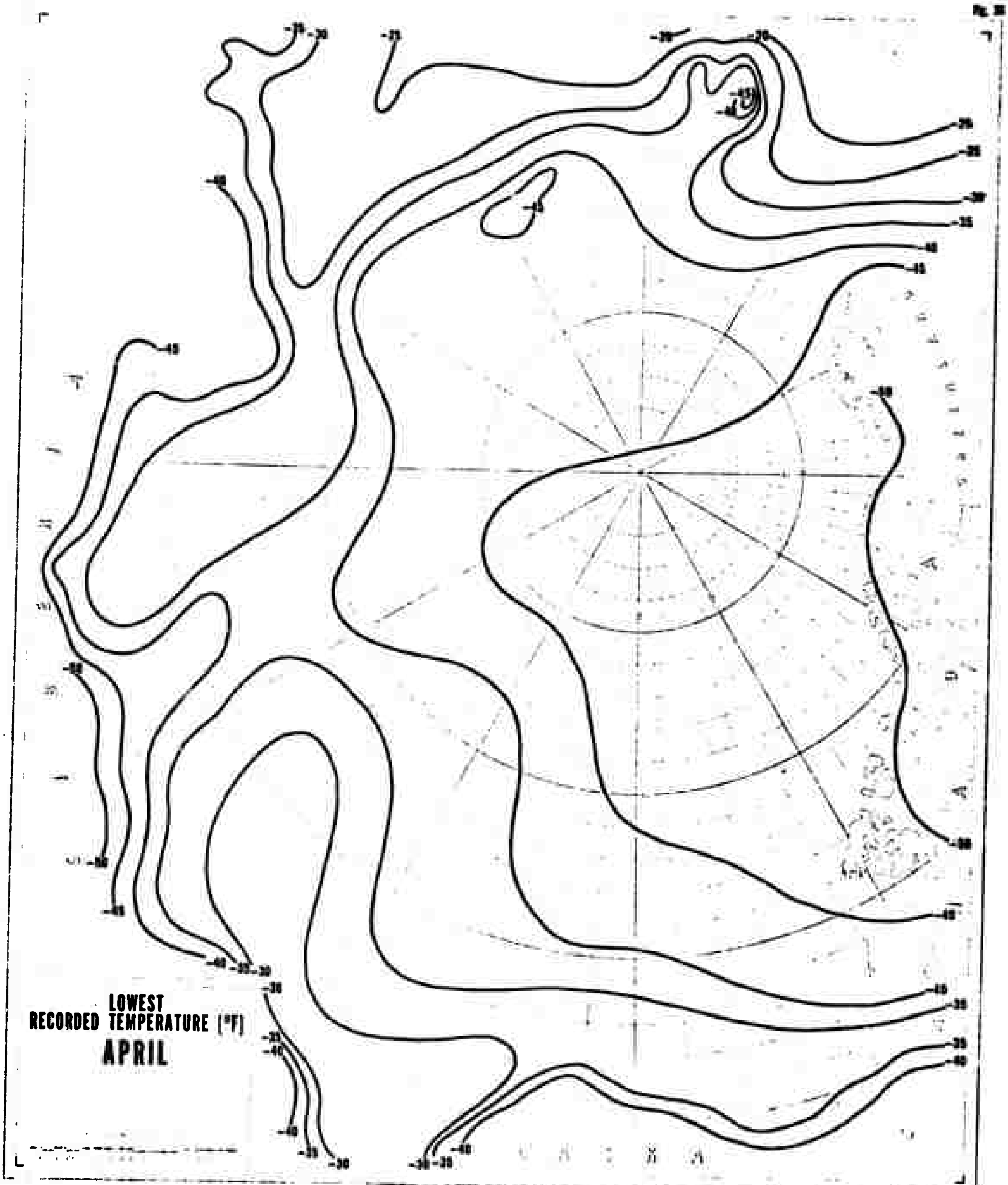


LOWEST
RECORDED TEMPERATURE (°F)
JANUARY

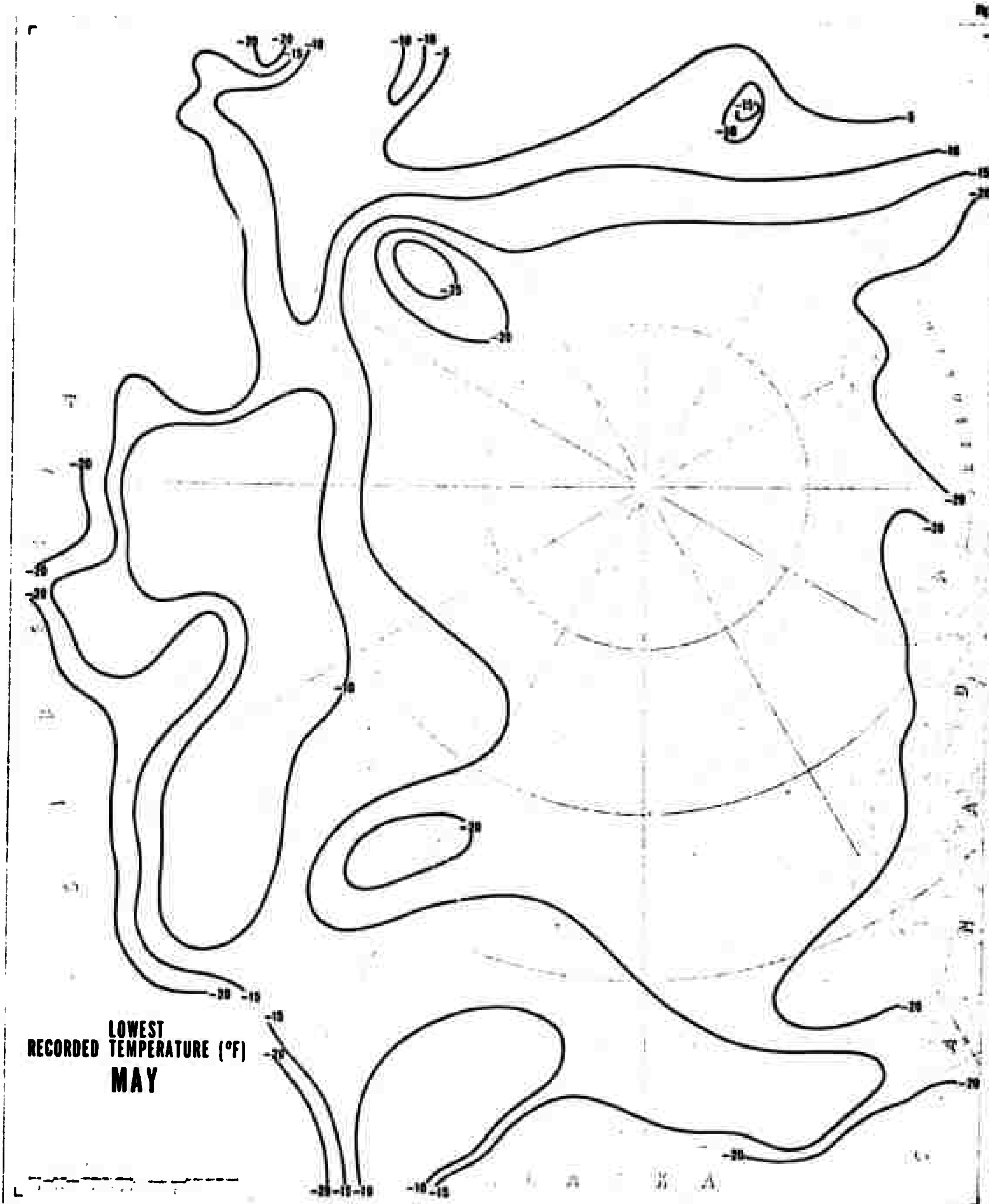


LOWEST
RECORDED TEMPERATURE (°F)
FEBRUARY


LOWEST
RECORDED TEMPERATURE (°F)
MARCH



LOWEST
RECORDED TEMPERATURE (°F)
APRIL



LOWEST
RECORDED TEMPERATURE (°F)
MAY

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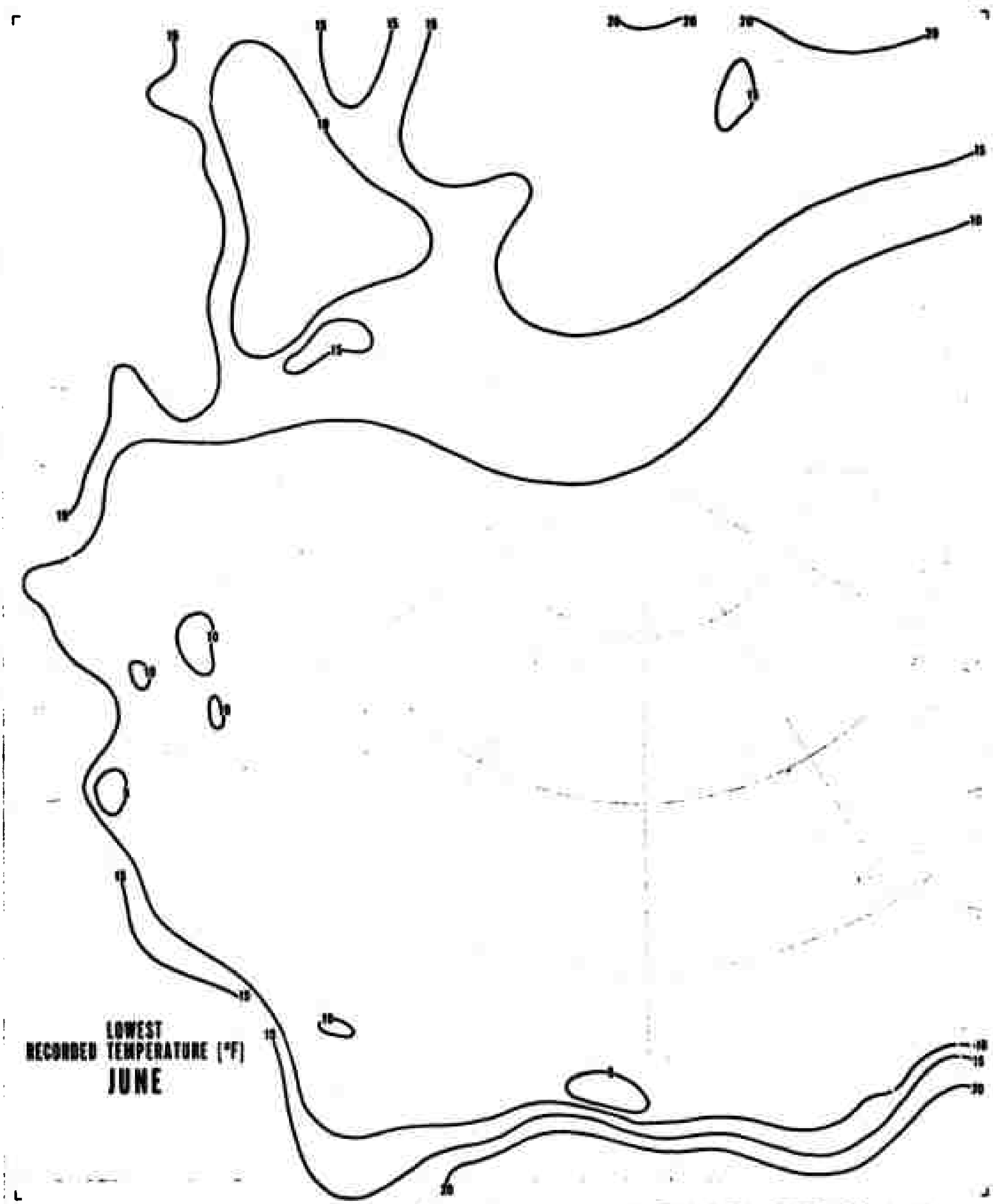
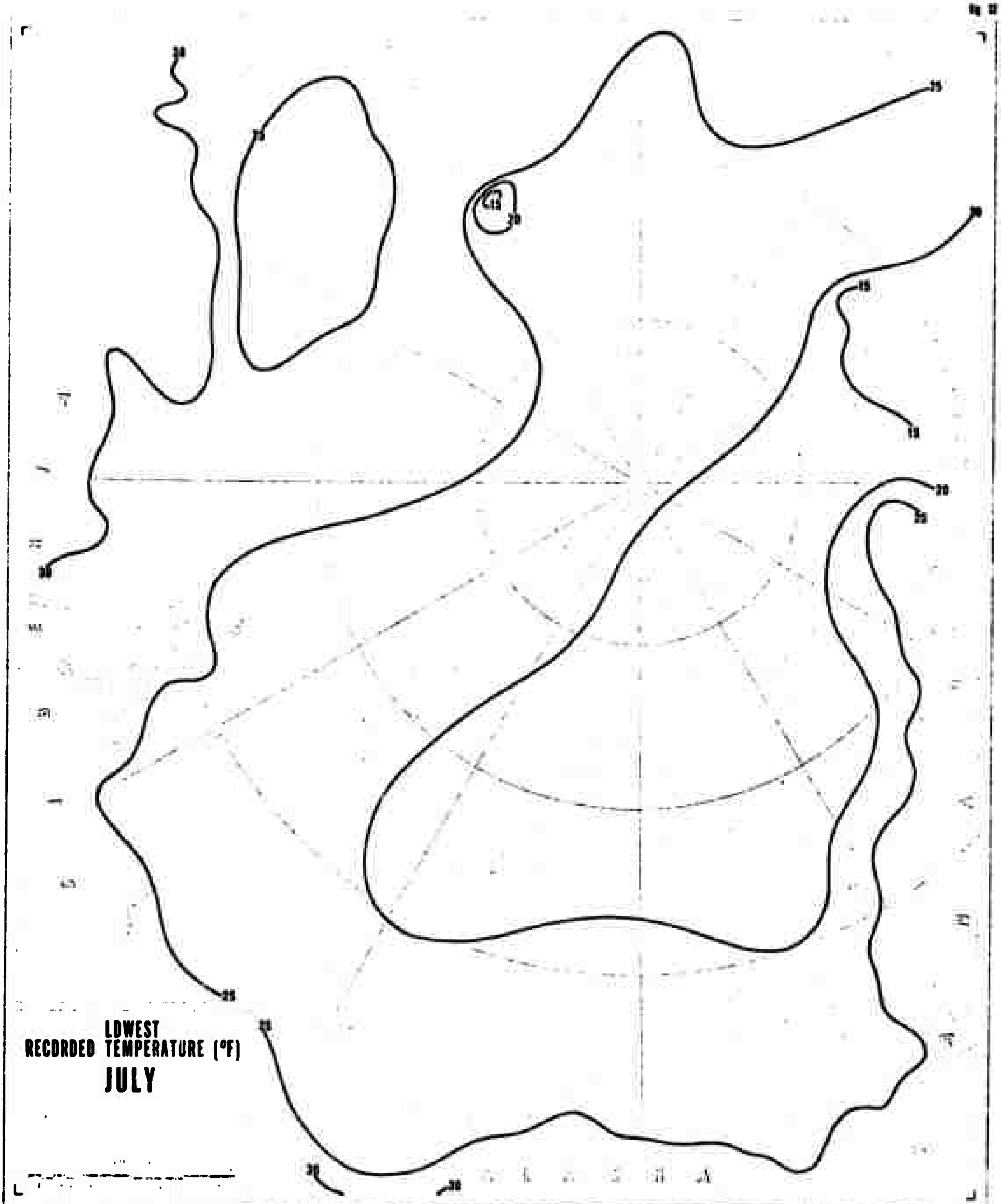
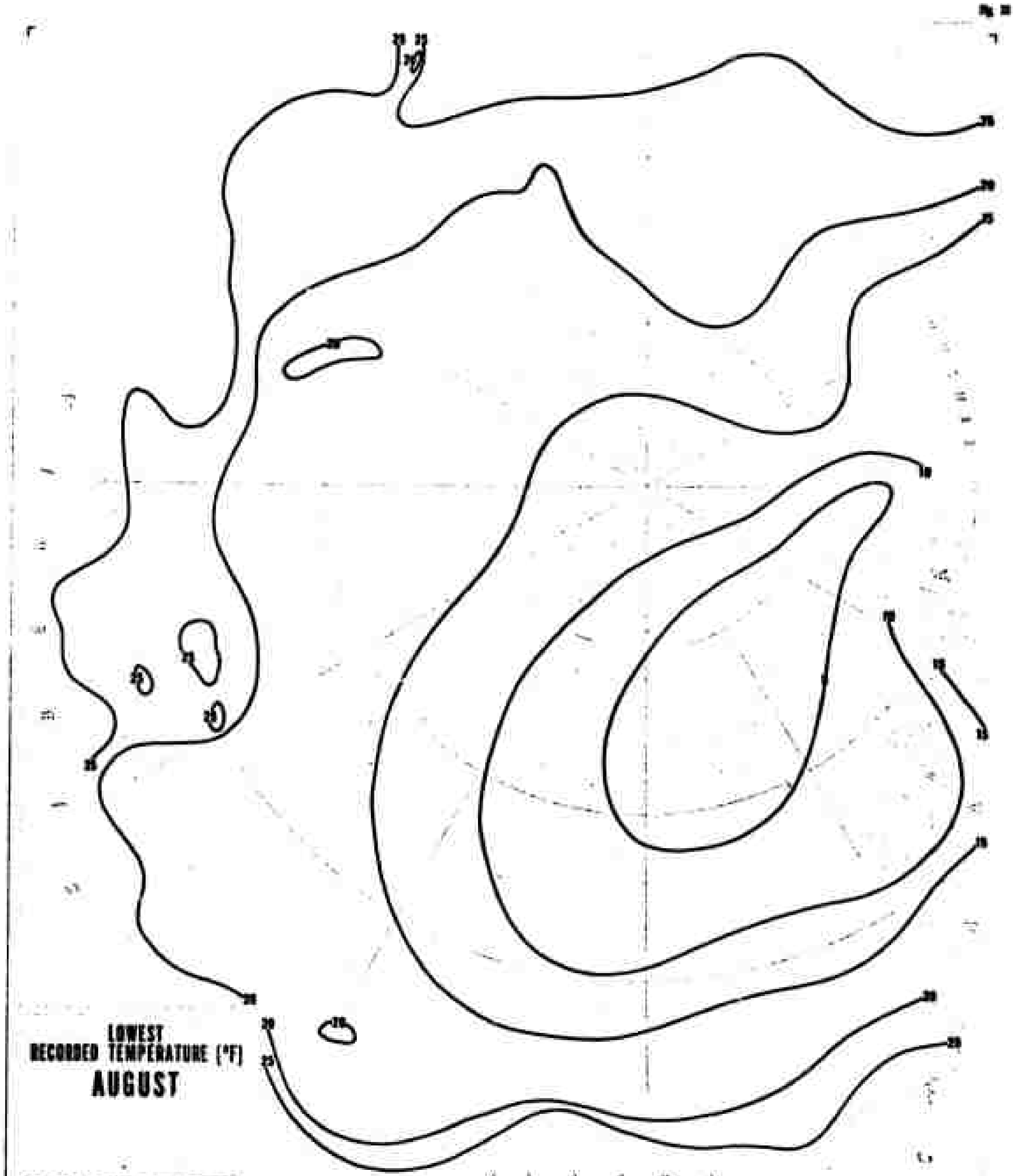
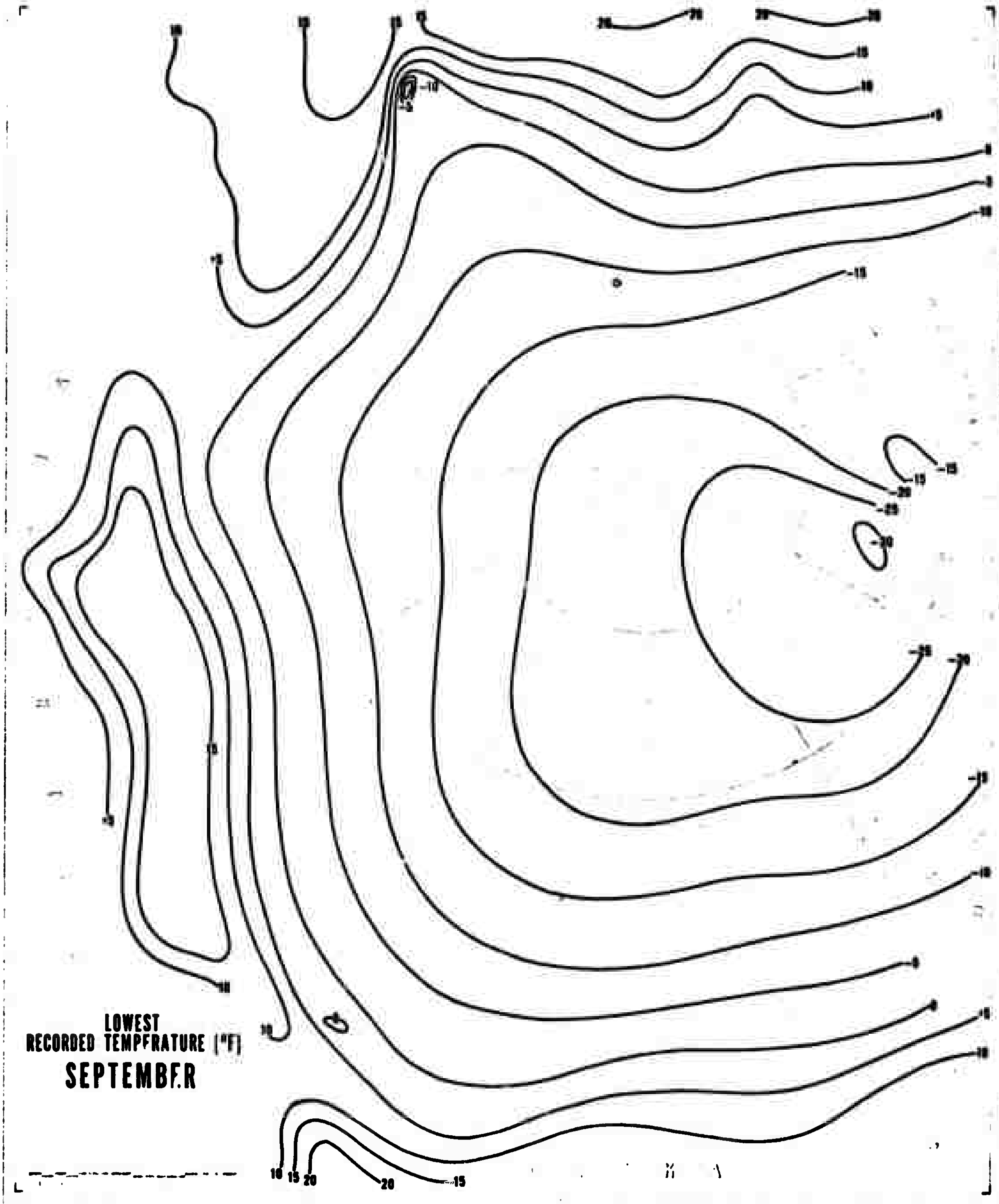


RECORDED LOWEST TEMPERATURE (°F)
JUNE

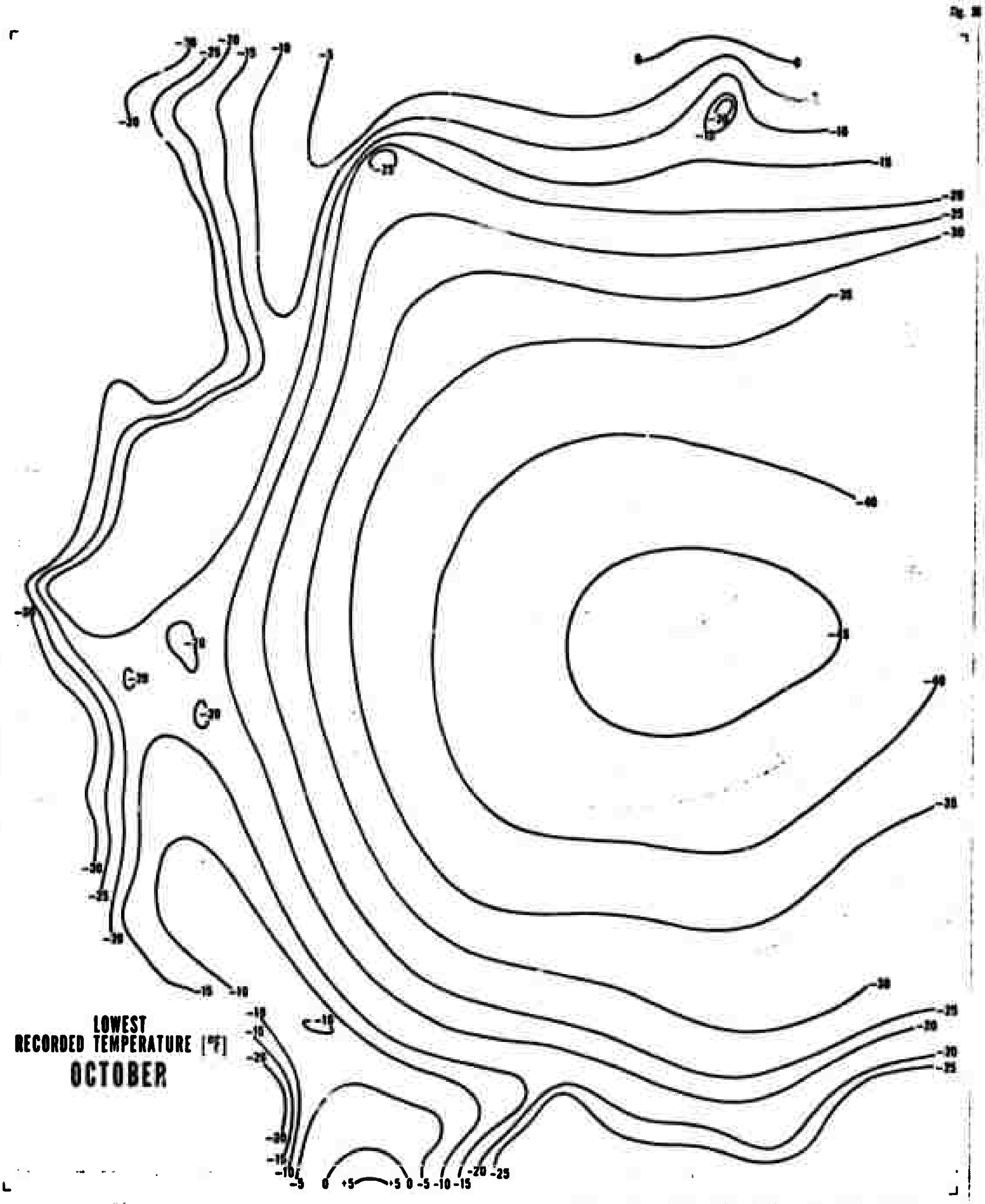


LOWEST RECORDED TEMPERATURE (°F)
JULY

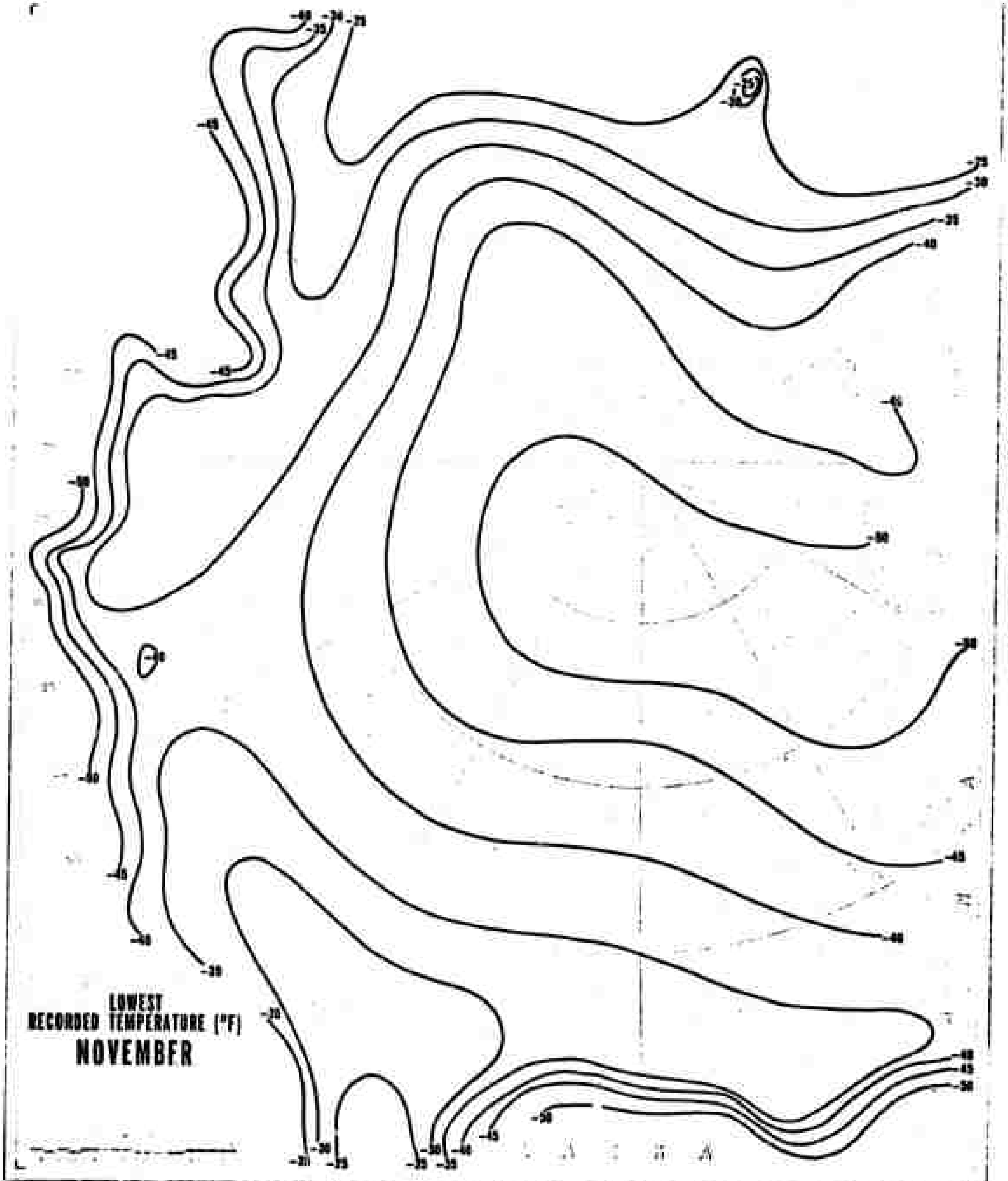

LOWEST
RECORDED TEMPERATURE (°F)
AUGUST



LOWEST
RECORDED TEMPERATURE (°F)
SEPTEMBER
20
15
-15
-10
-20
-25
-30

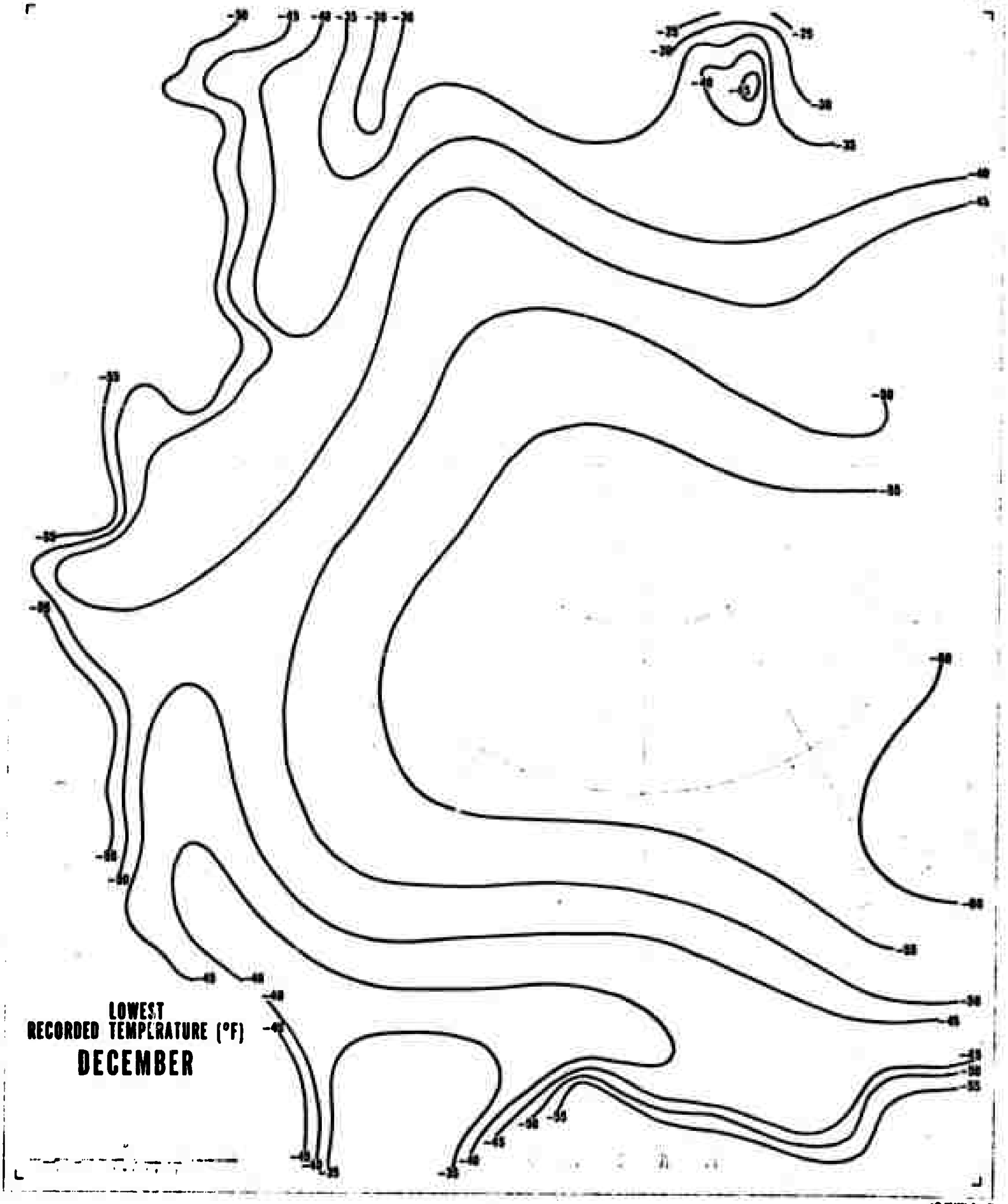


LOWEST
RECORDED TEMPERATURE [°F]
OCTOBER



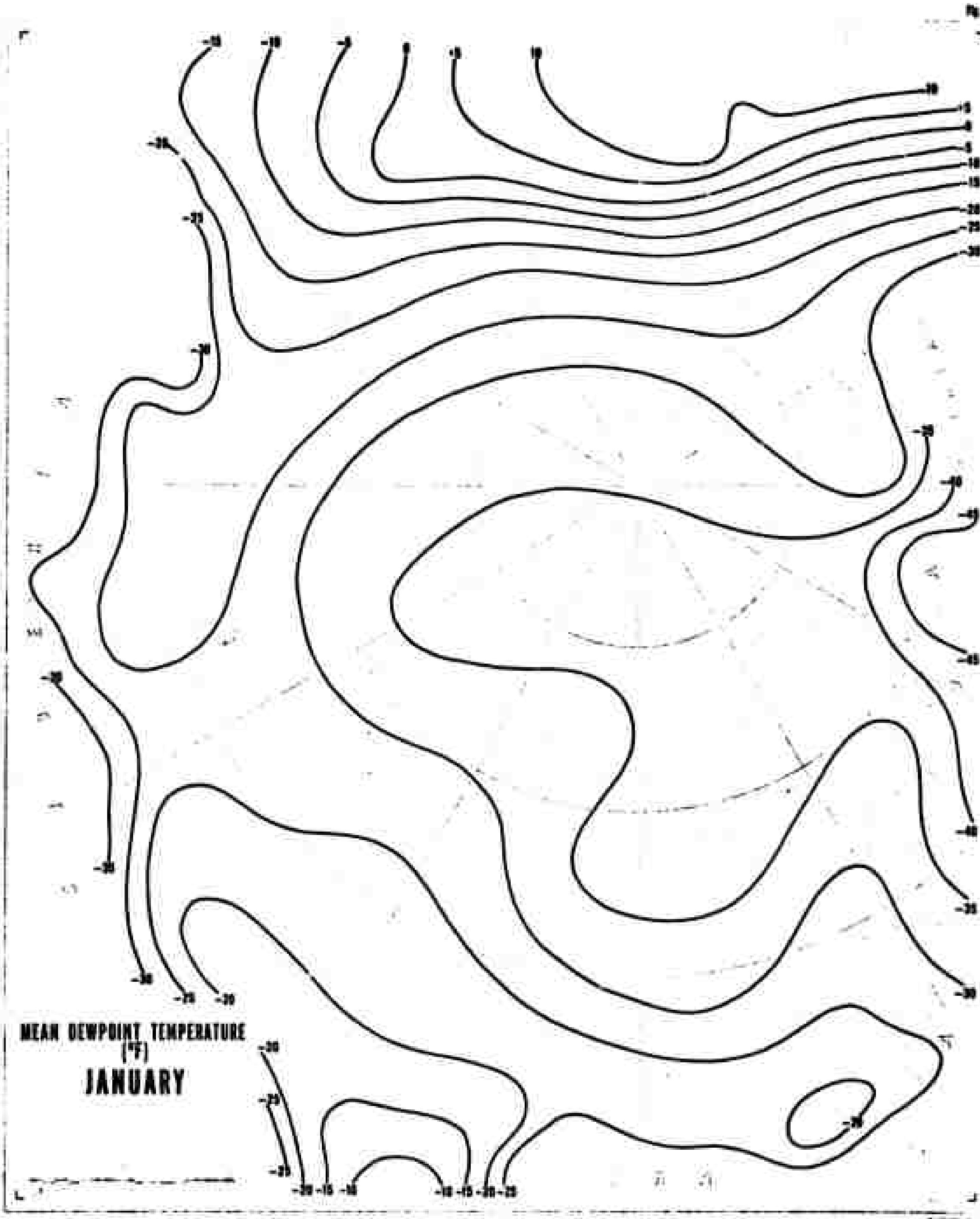
LOWEST
RECORDED TEMPERATURE (°F)
NOVEMBER

6th USAETL Sep 71



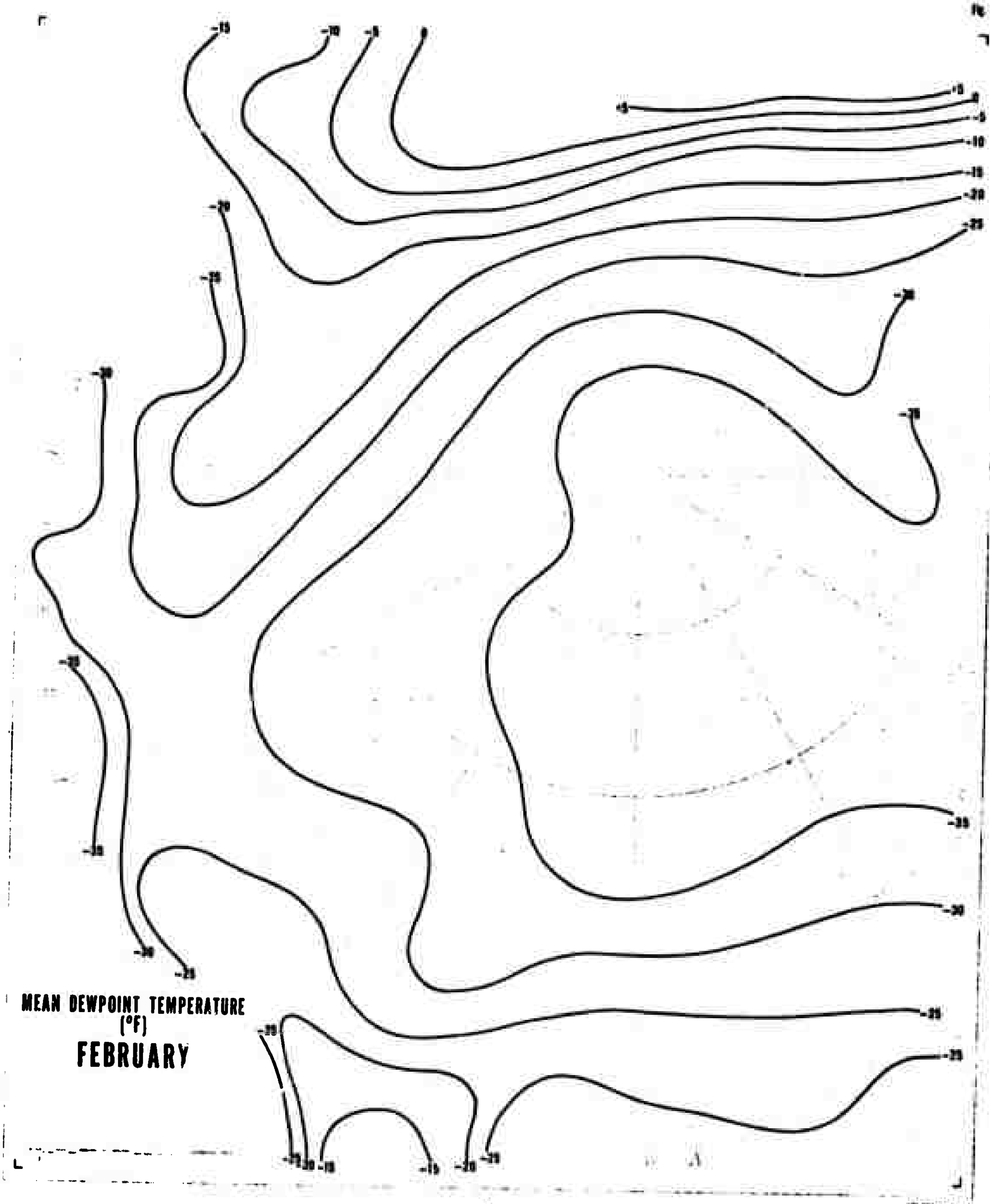
LOWEST
RECORDED TEMPERATURE (°F)
DECEMBER

Fig. 30



MEAN DEWPOINT TEMPERATURE (°F)

JANUARY



MEAN DEWPOINT TEMPERATURE (°F)

FEBRUARY

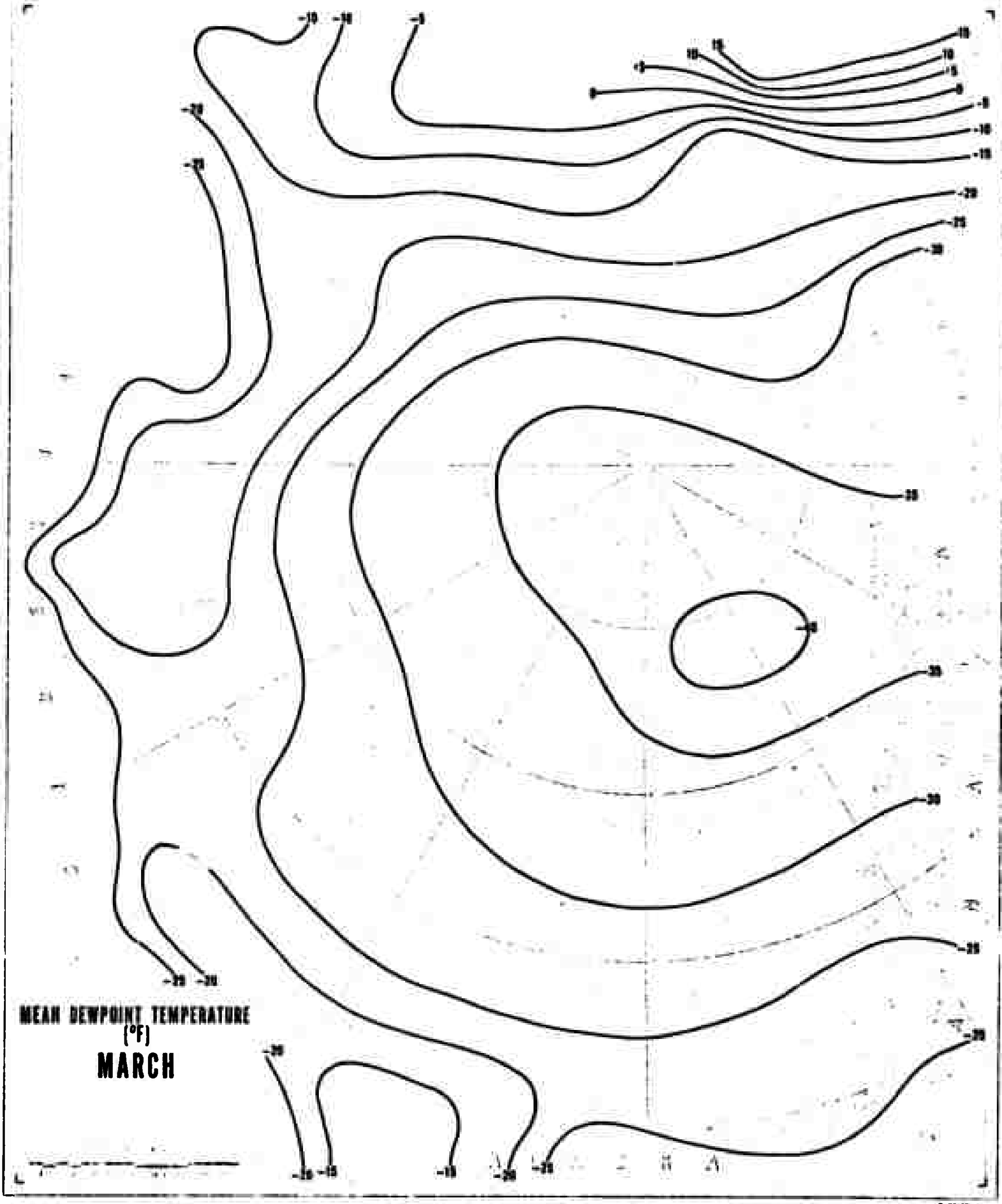
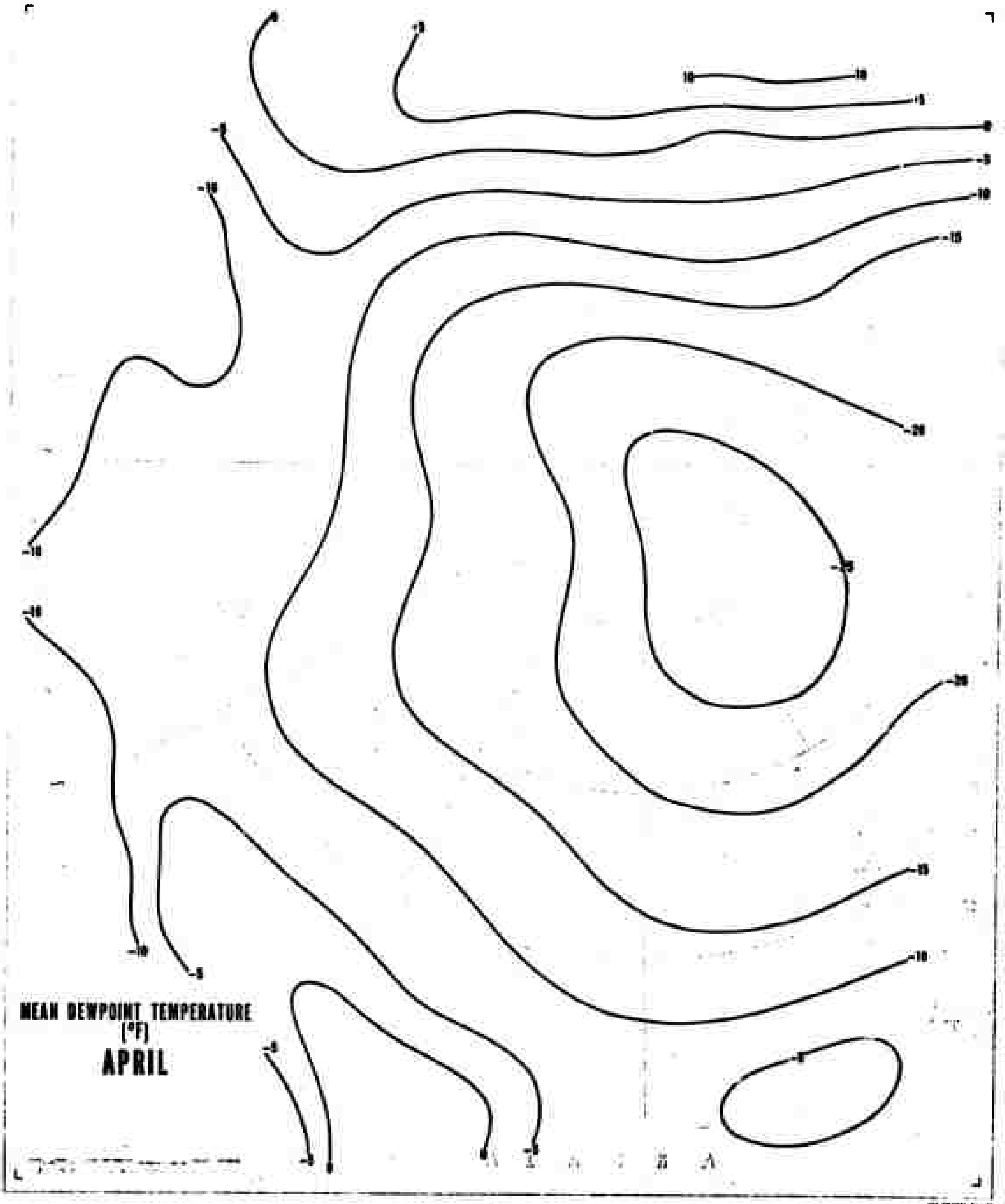
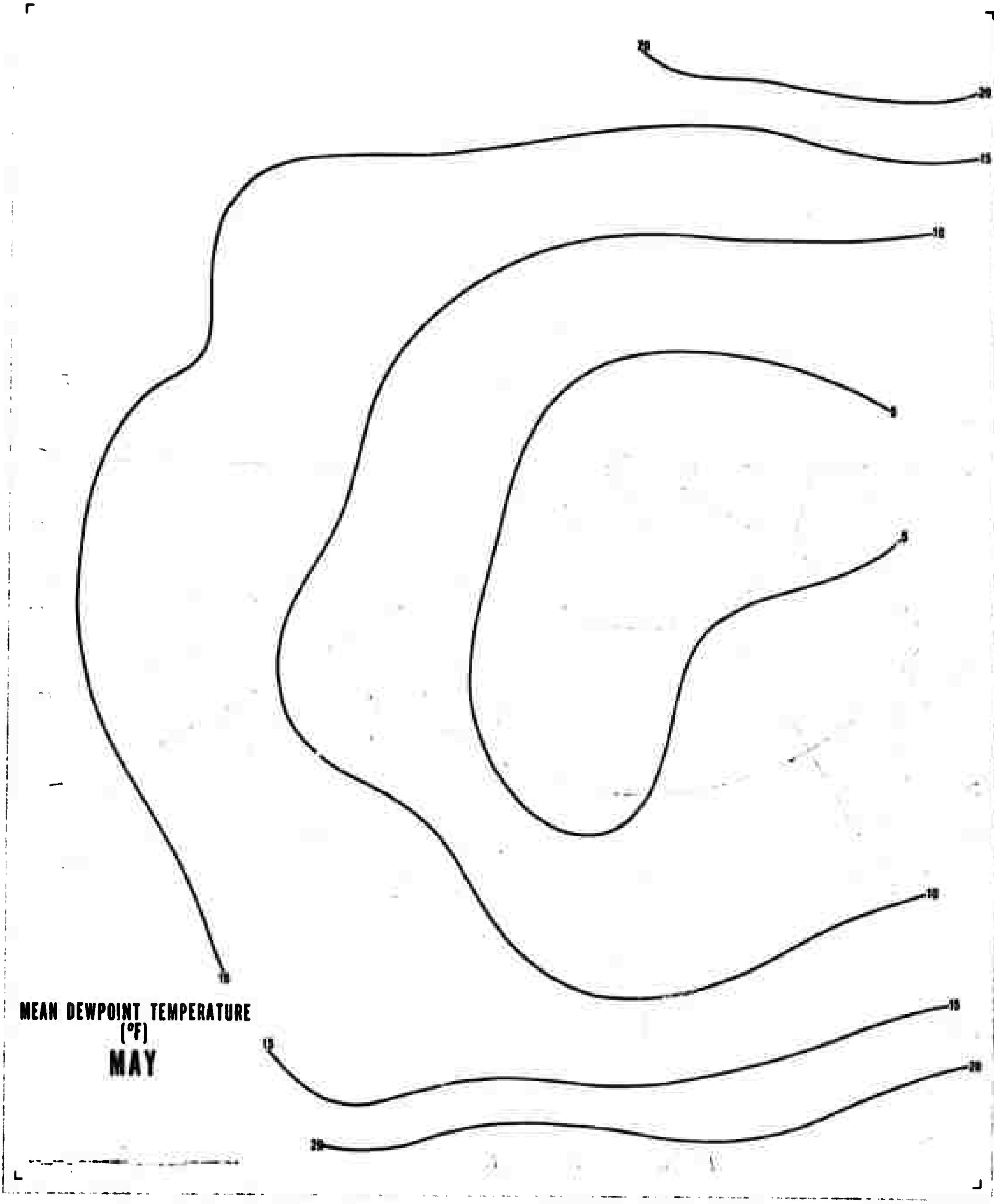

MEAN DEWPOINT TEMPERATURE
(°F)
MARCH

Fig. 41



MEAN DEWPOINT TEMPERATURE
(°F)
APRIL

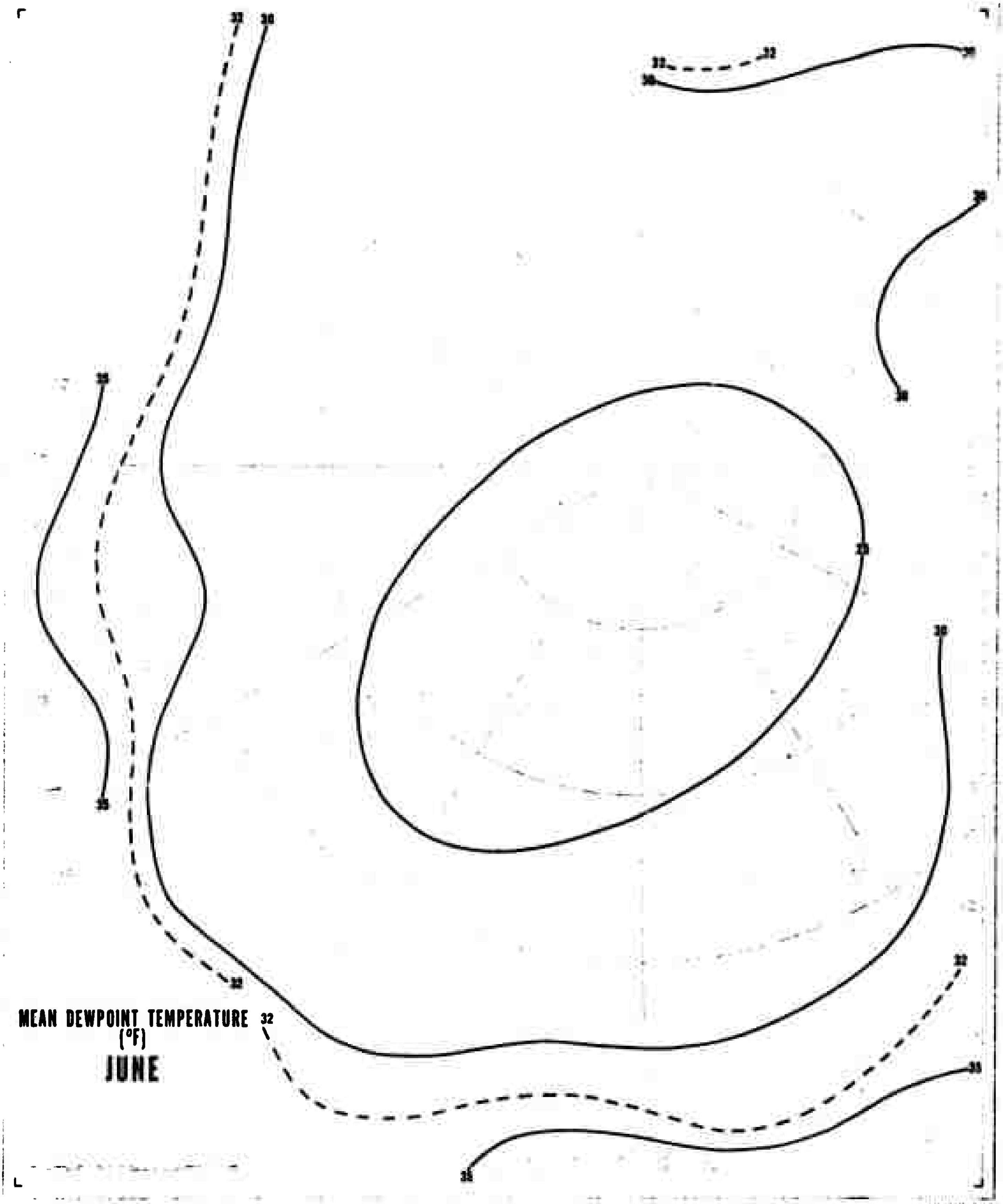
Fig. 42



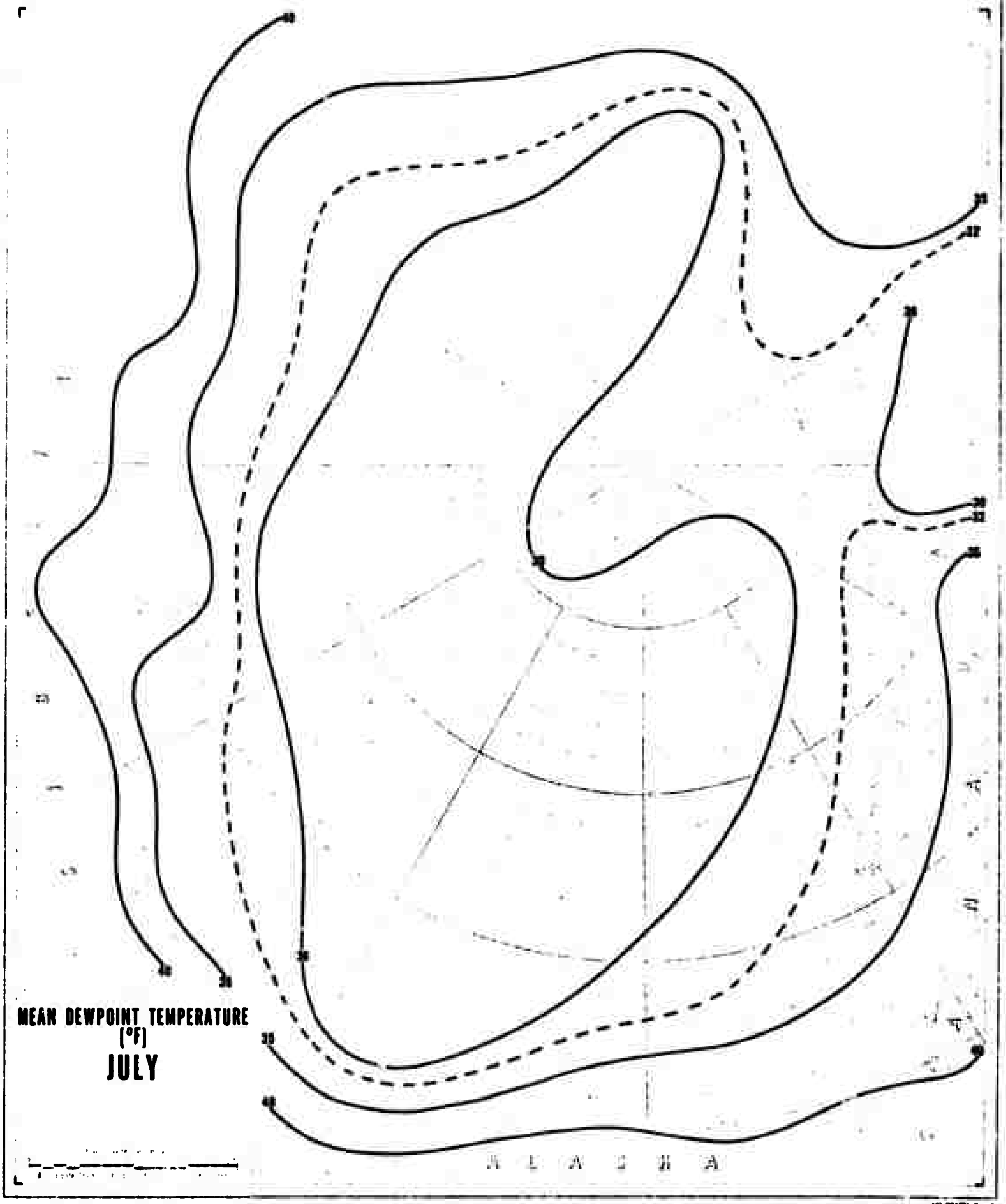
MEAN DEWPOINT TEMPERATURE (°F)

MAY

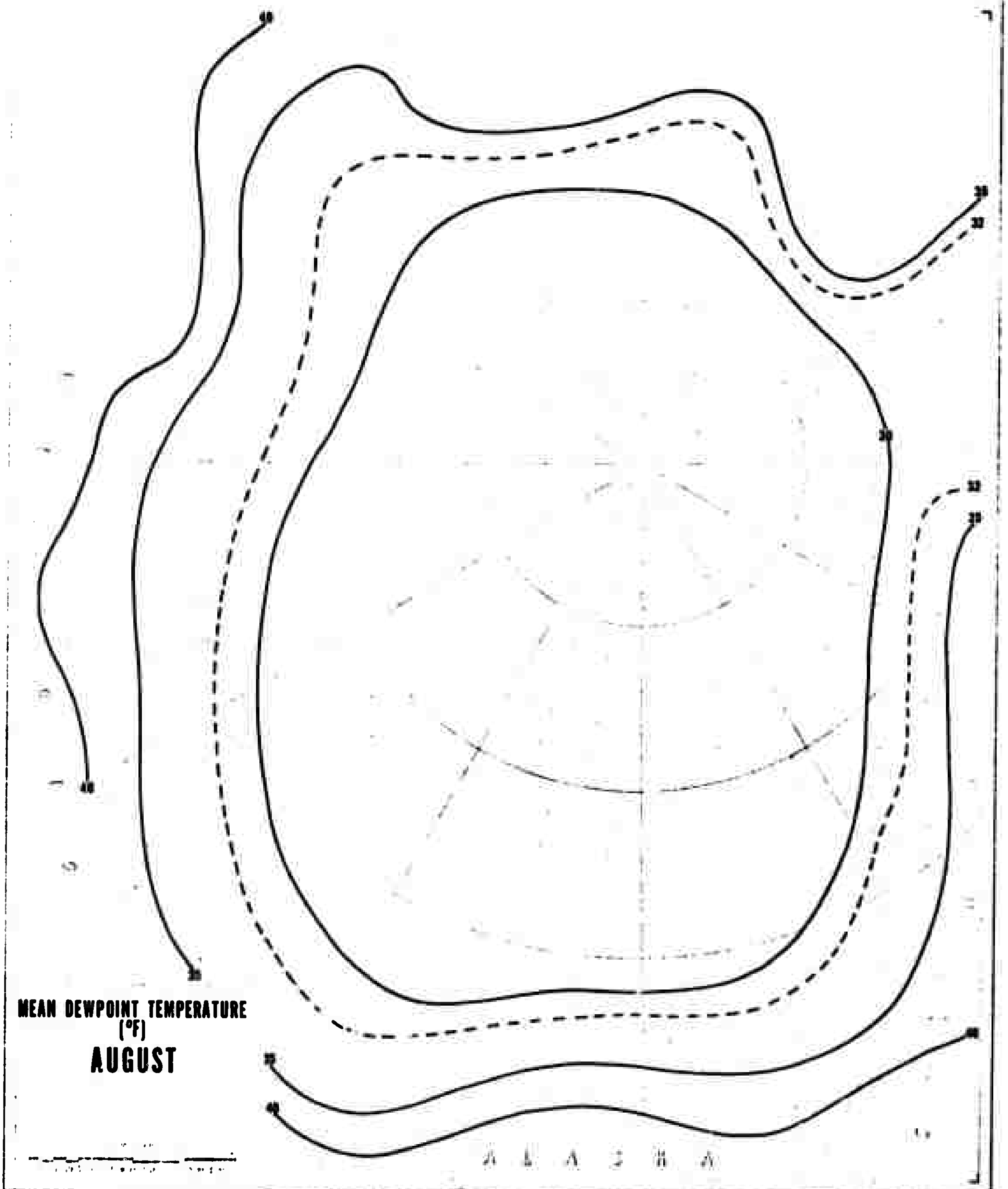
Fig. 43



MEAN DEWPOINT TEMPERATURE
(°F)
JUNE

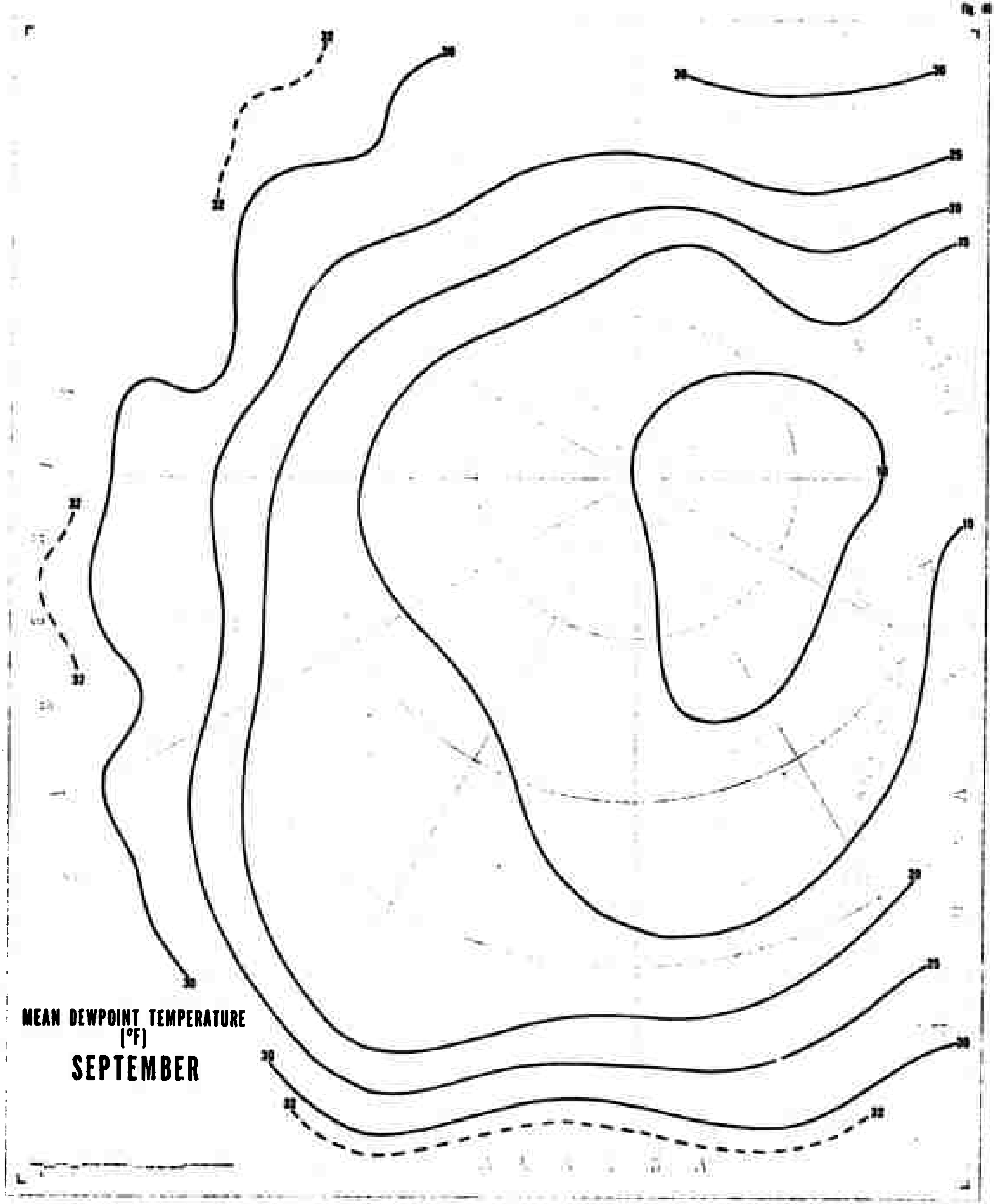


MEAN DEWPOINT TEMPERATURE
(°F)
JULY



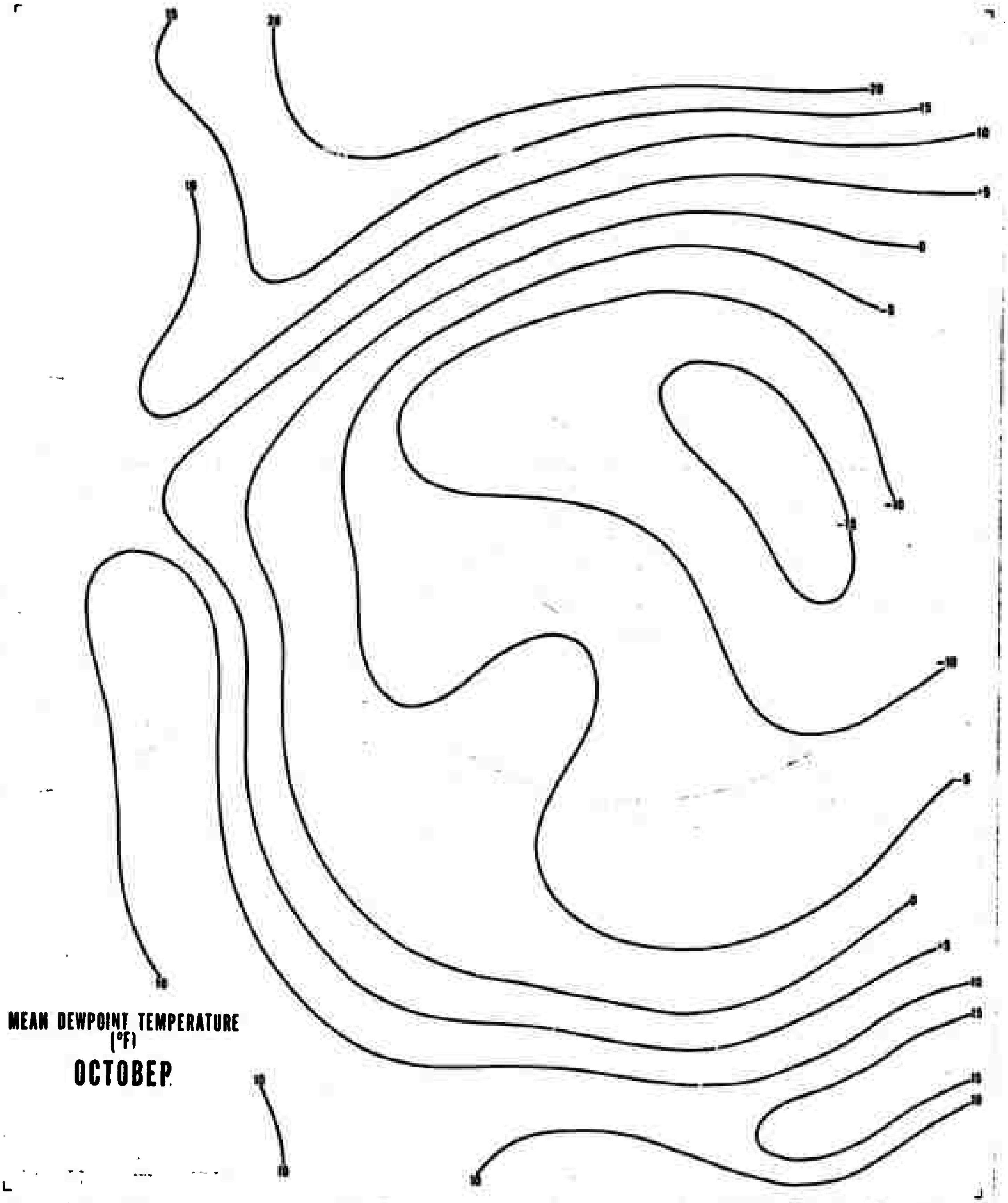
MEAN DEWPOINT TEMPERATURE (°F)

AUGUST



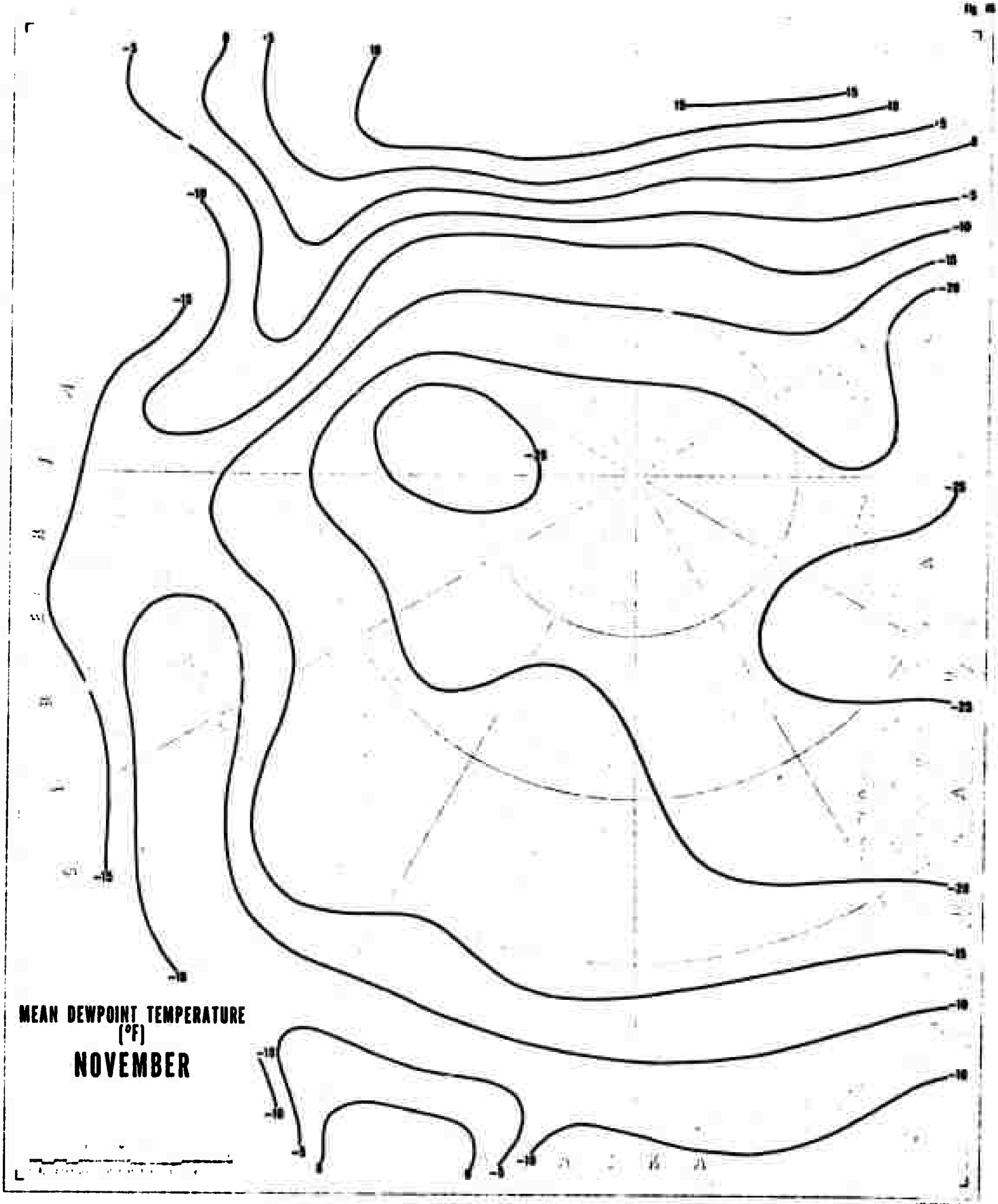
MEAN DEWPOINT TEMPERATURE
(°F)
SEPTEMBER

Fig. 47

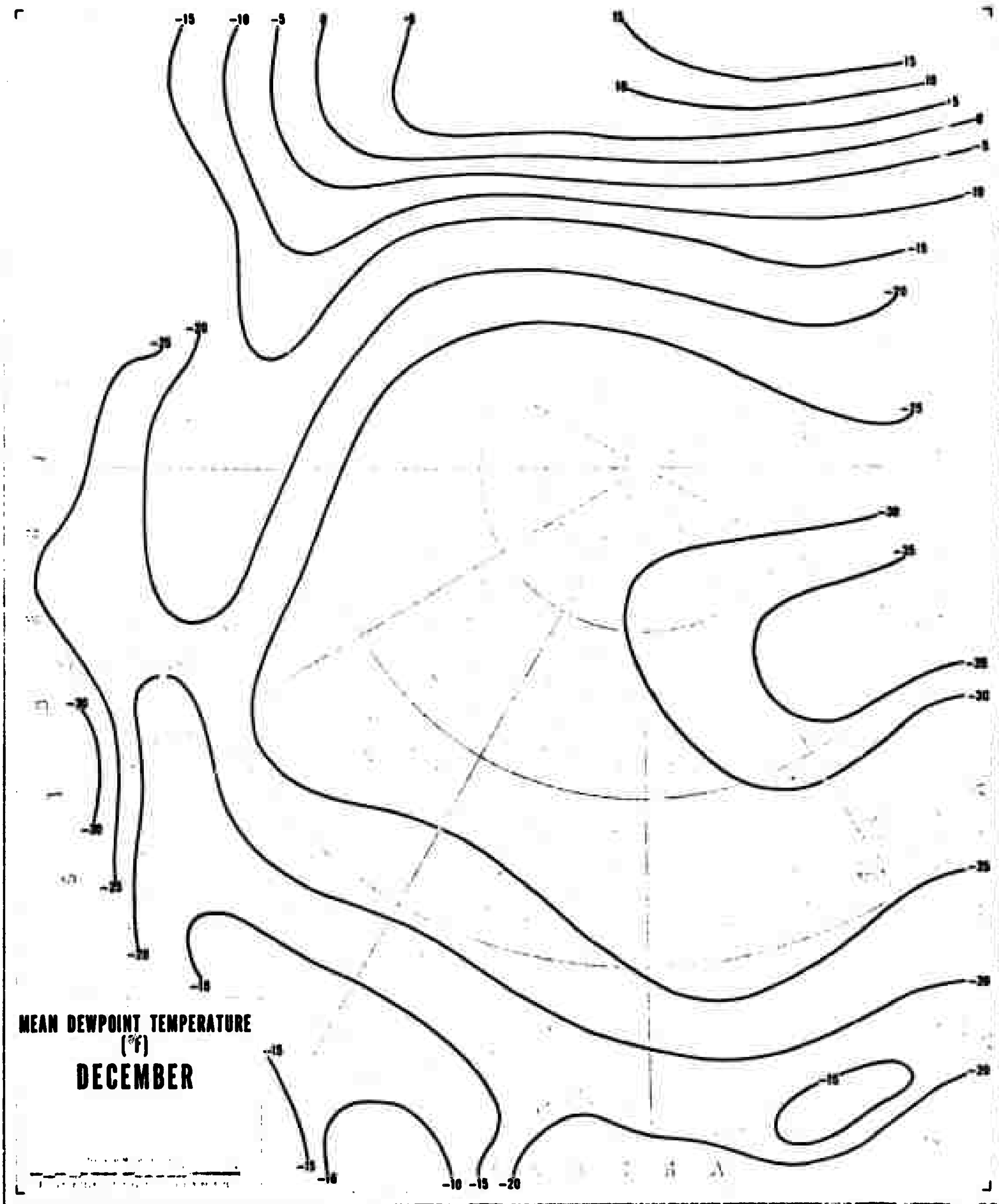


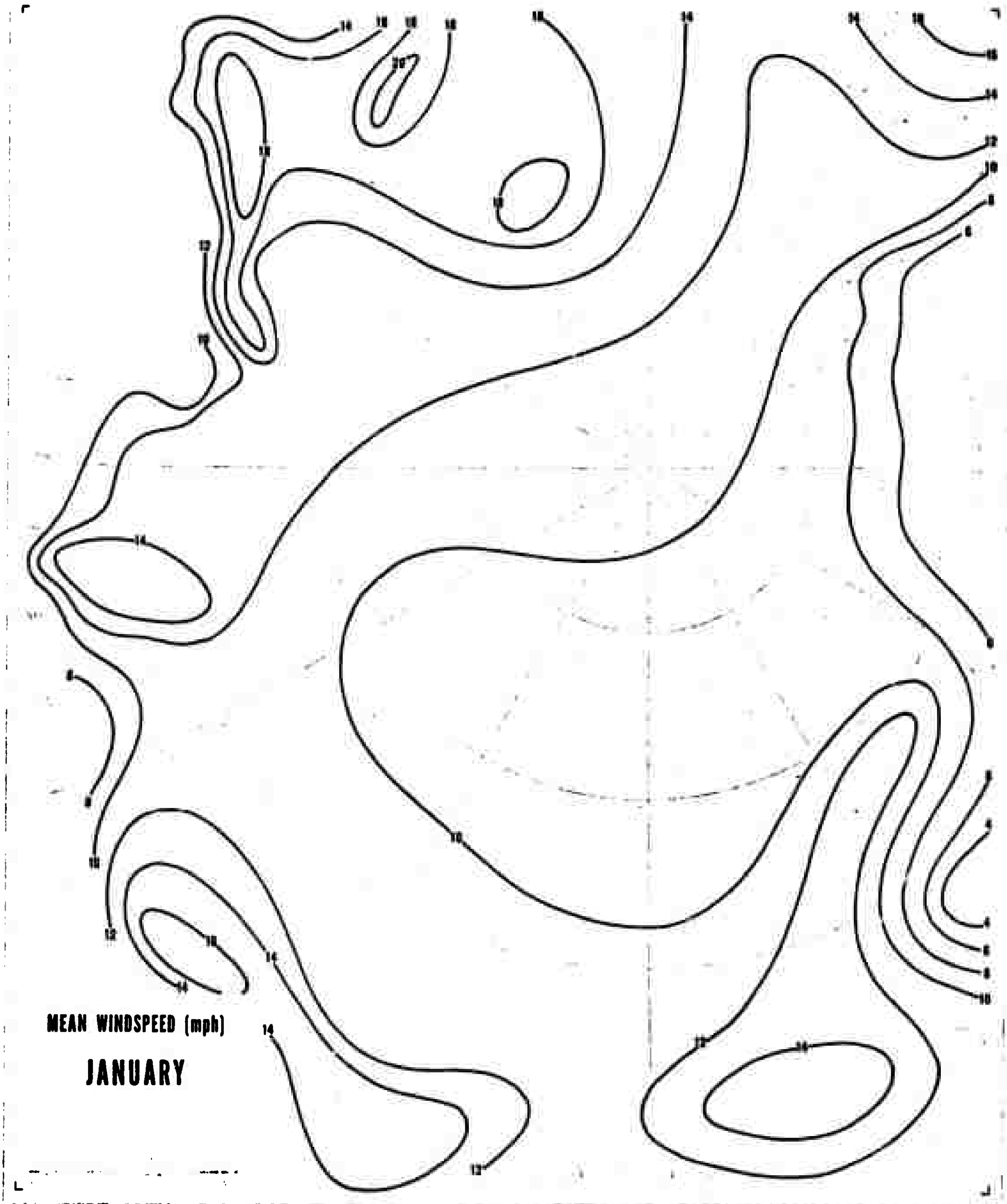
MEAN DEWPOINT TEMPERATURE (°F)

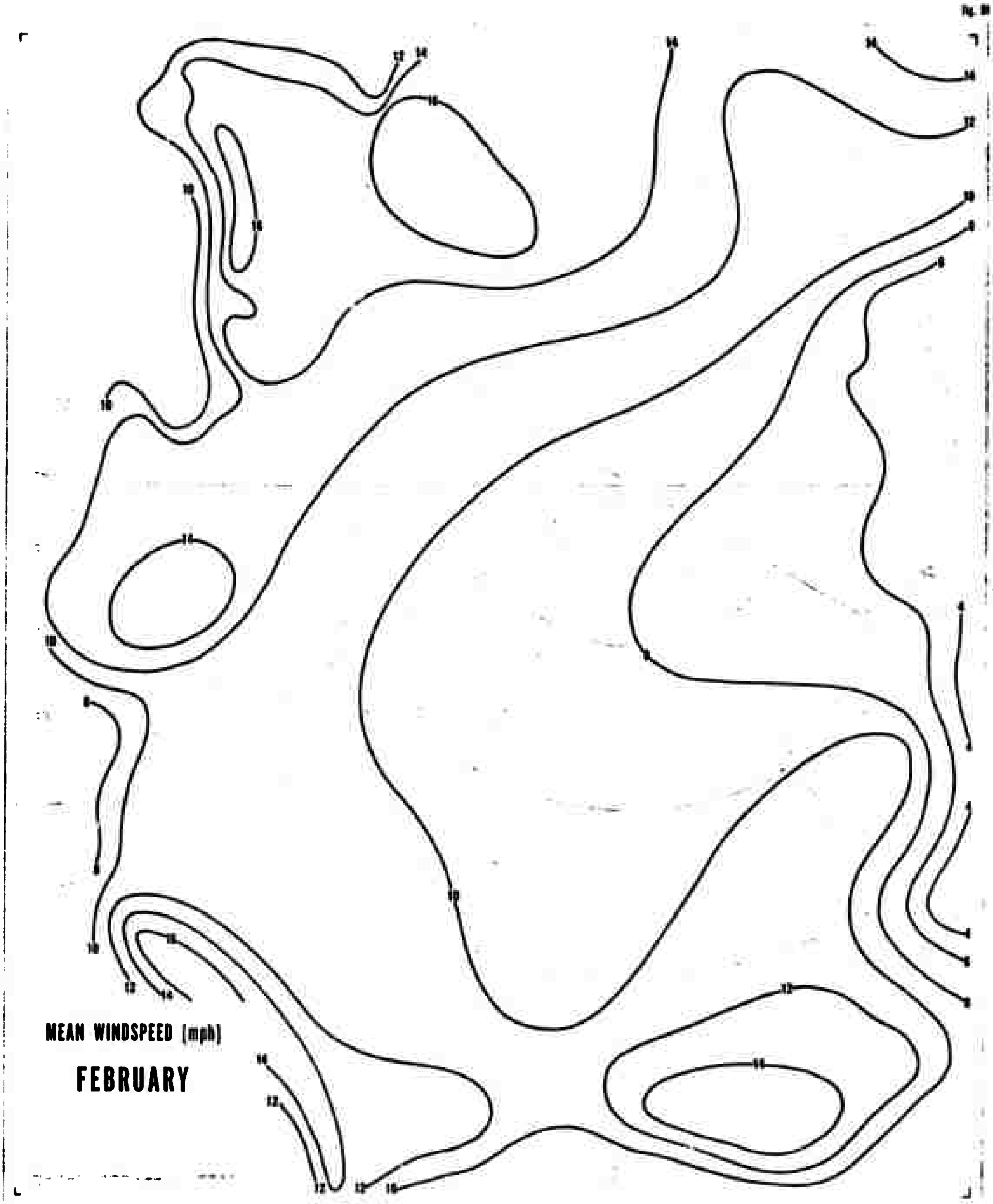
OCTOBER

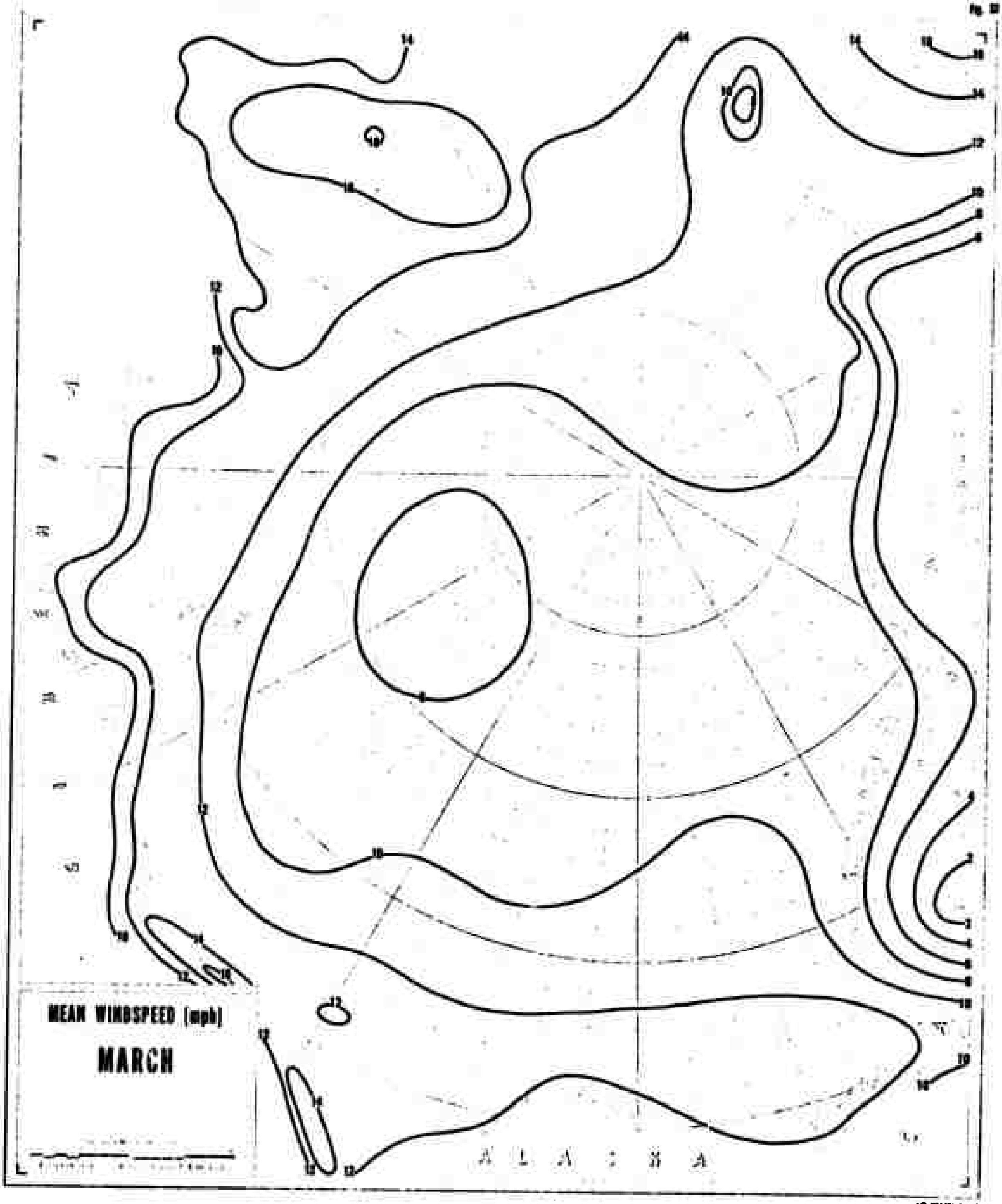


MEAN DEWPOINT TEMPERATURE (°F)
NOVEMBER

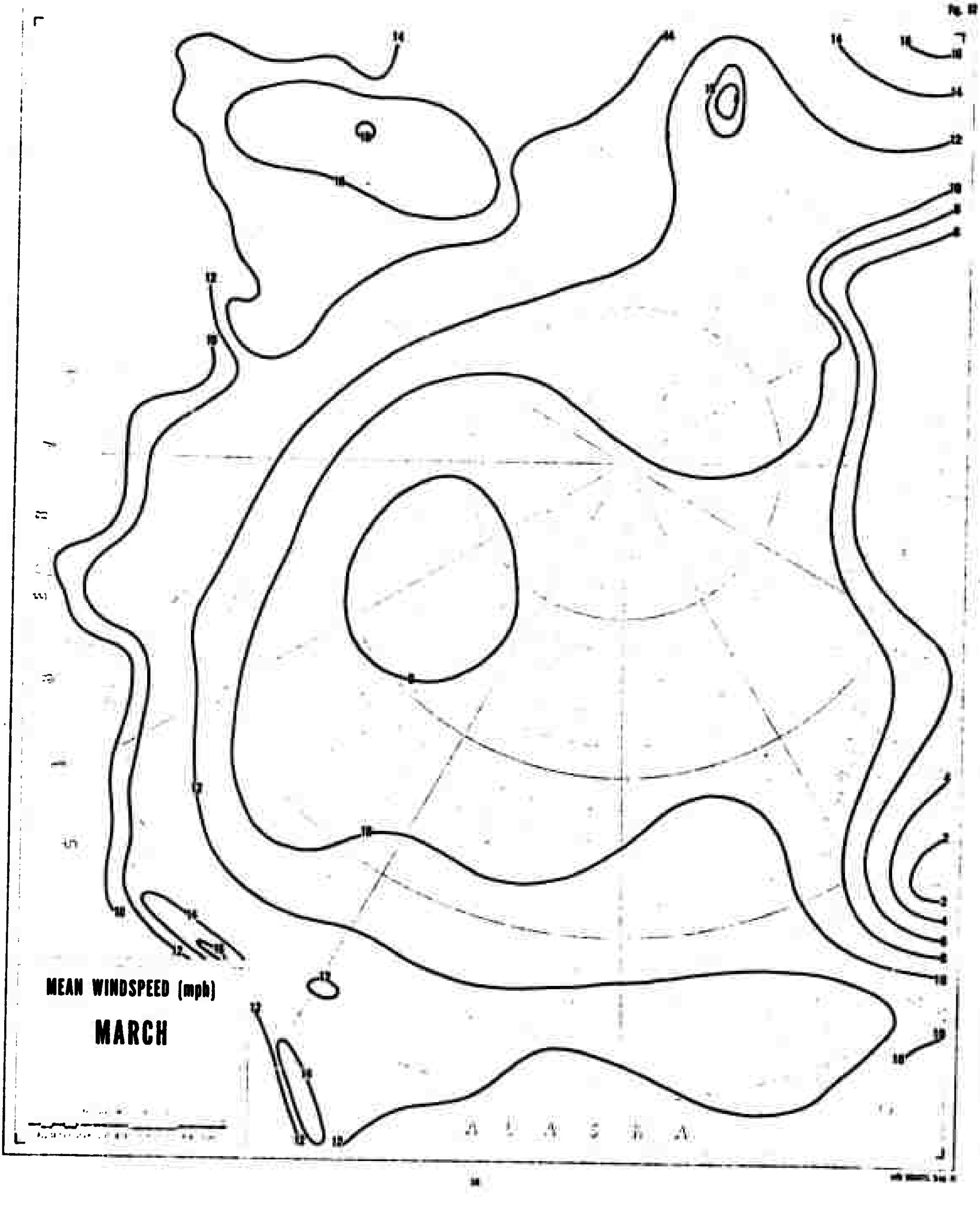

MEAN DEWPOINT TEMPERATURE
(°F)
DECEMBER
-15
-10
-5
0
15
10
5
-20
-25
-30

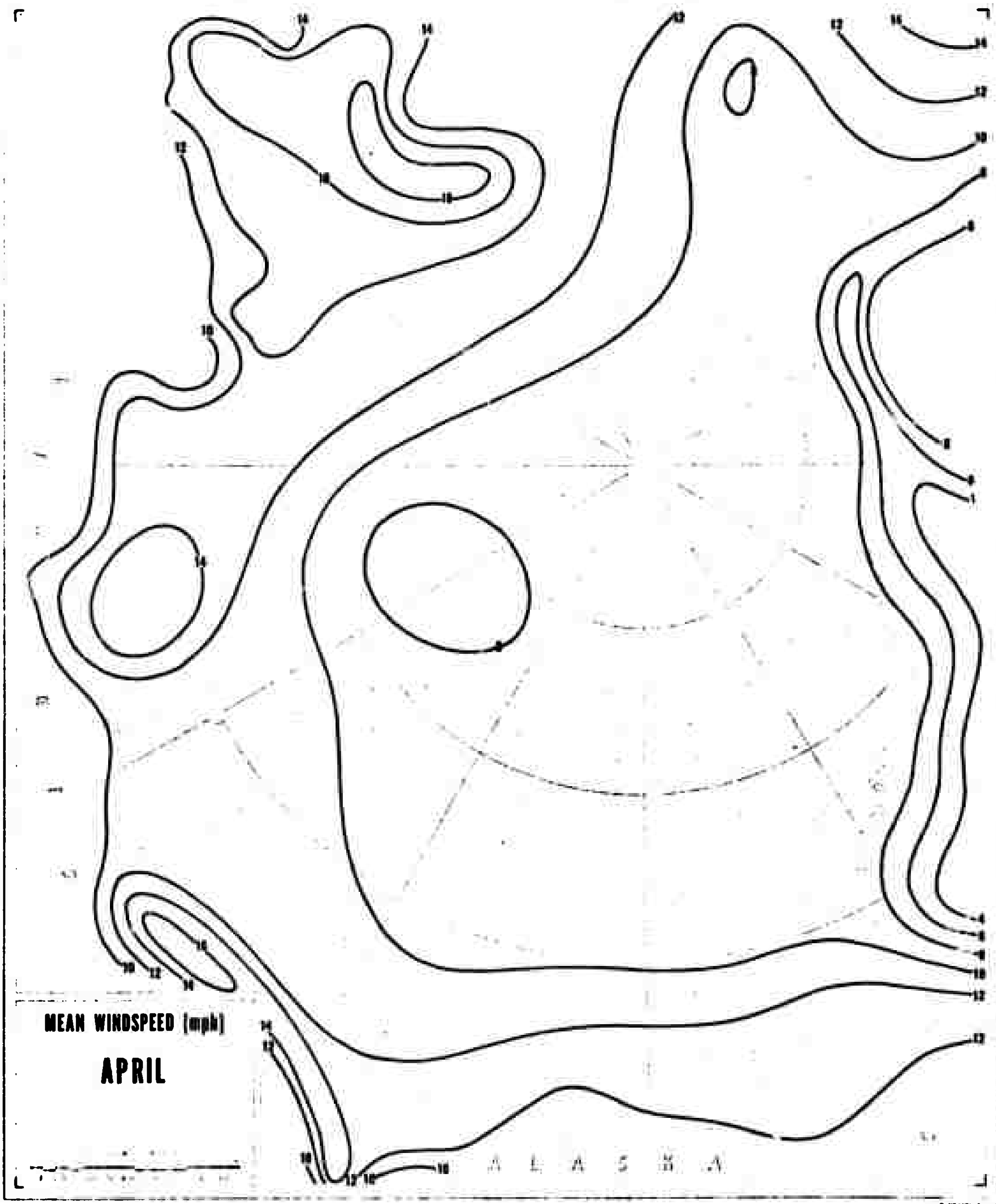

MEAN WINDSPEED (mph)
JANUARY


MEAN WINDSPEED (mph)
FEBRUARY



AM USAETL Sep 71


MEAN WINDSPEED (mph)
MARCH
ALASKA



MEAN WINDSPEED (mph)

APRIL

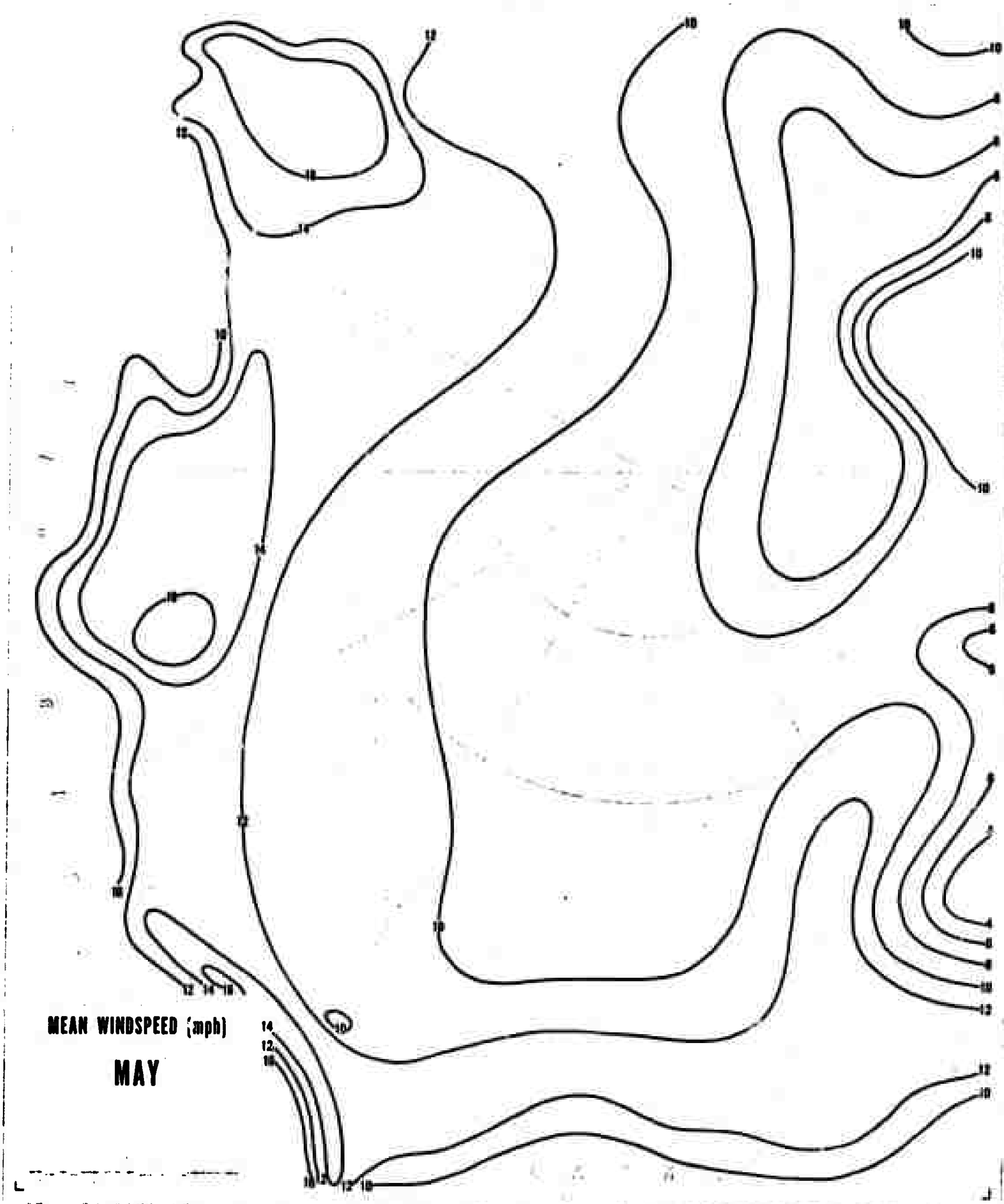
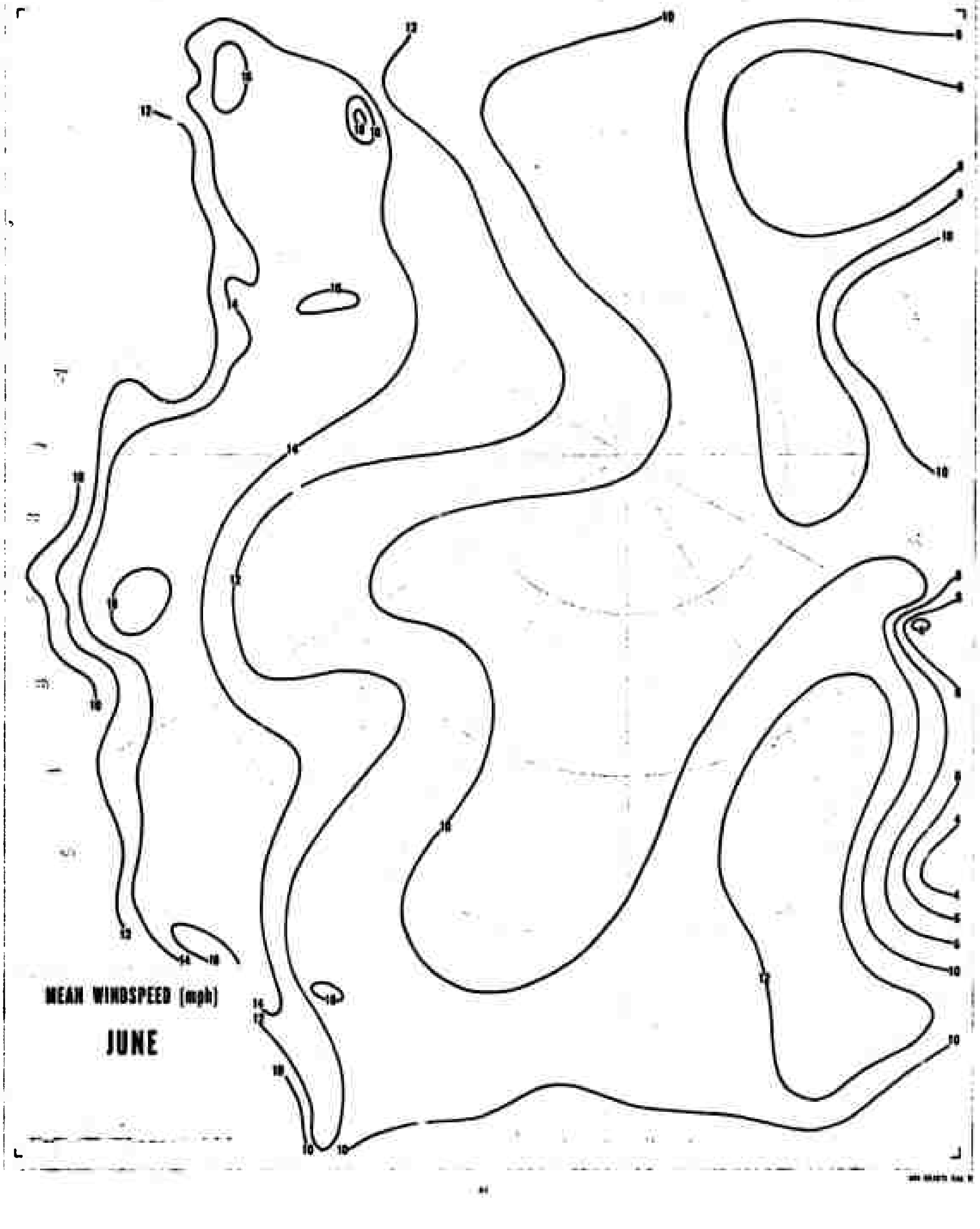
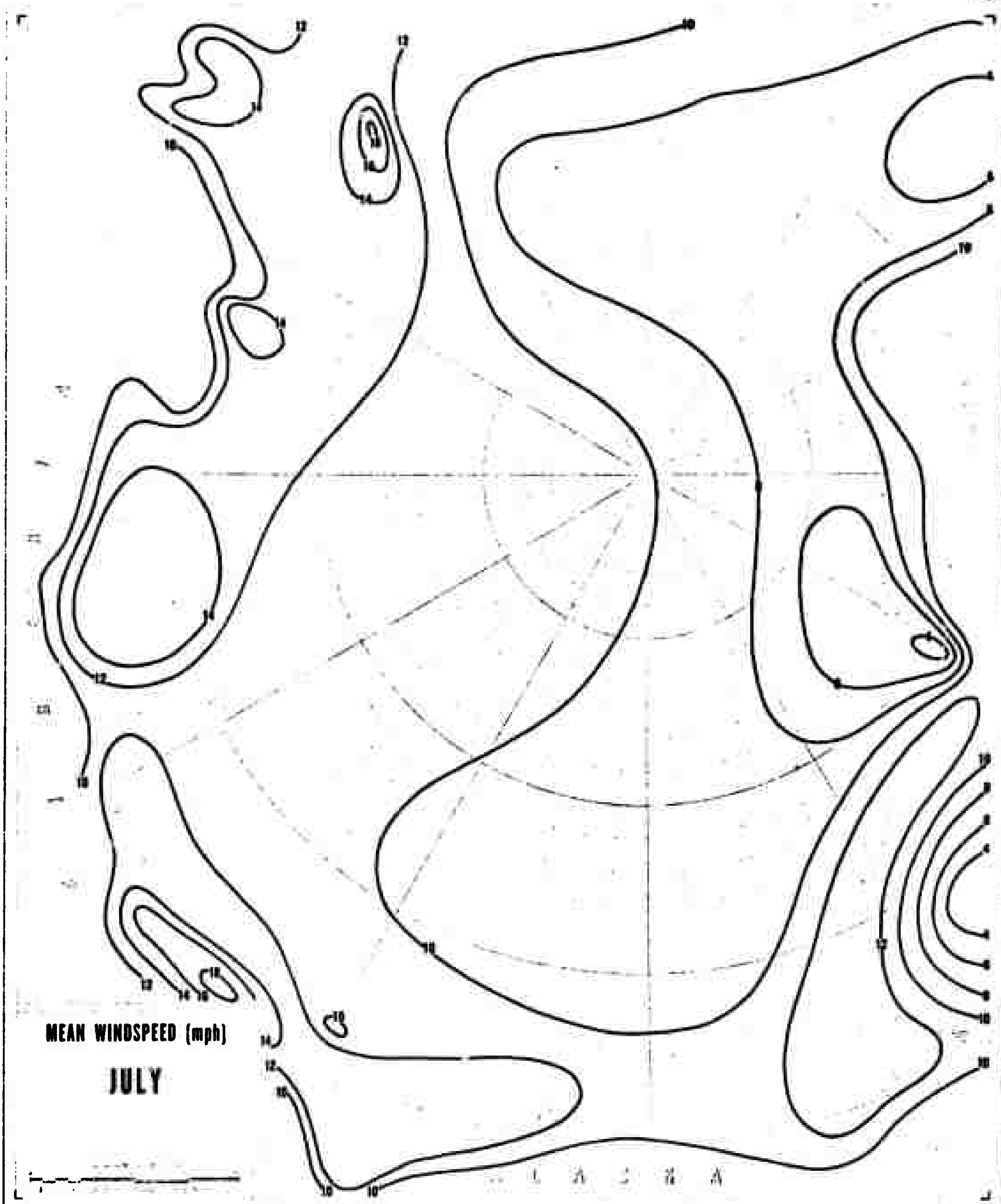

MEAN WINDSPEED (mph)
MAY

Fig. 55




MEAN WINDSPEED (mph)
JULY

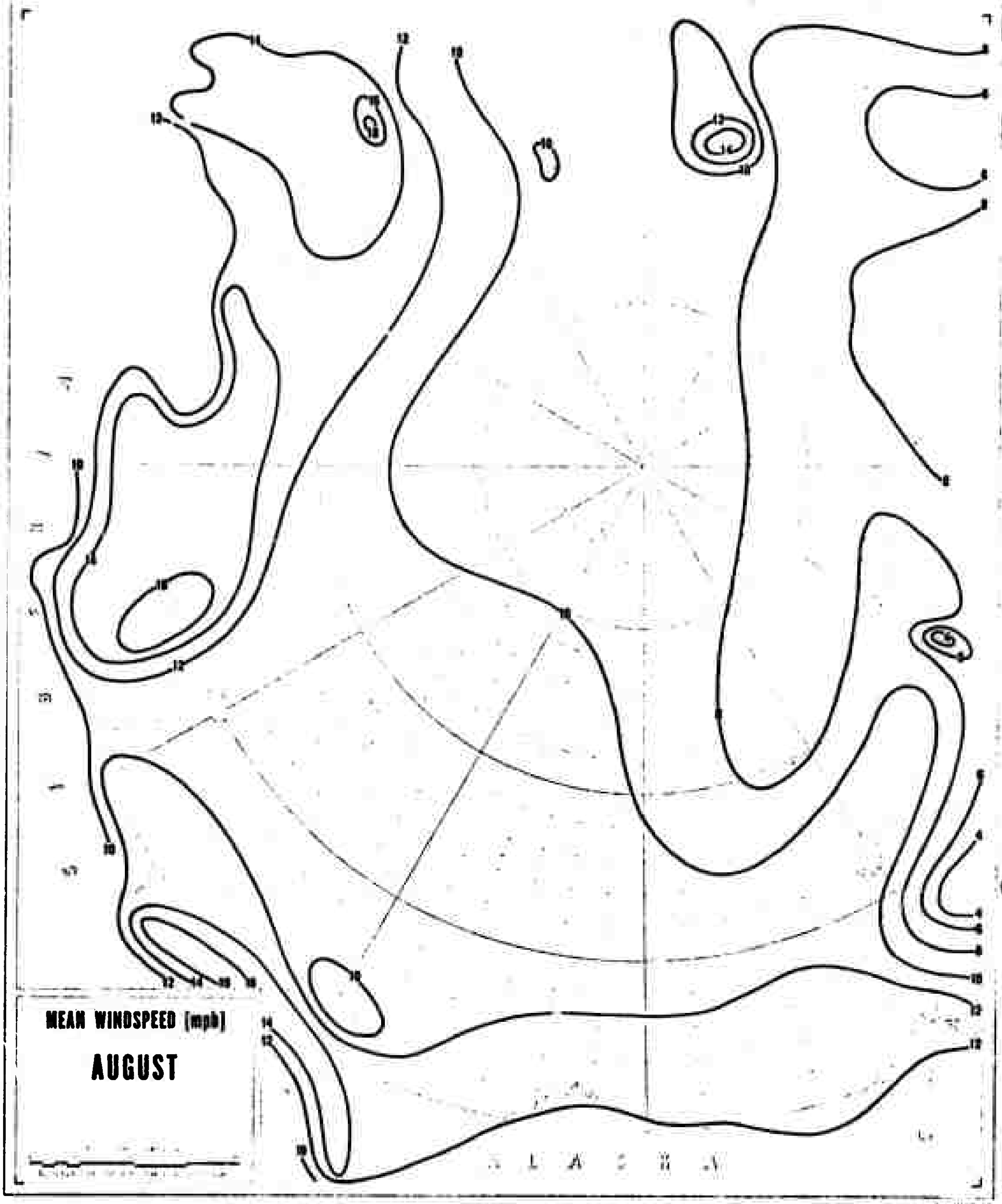

MEAN WINDSPEED (mph)
AUGUST

Fig. 50

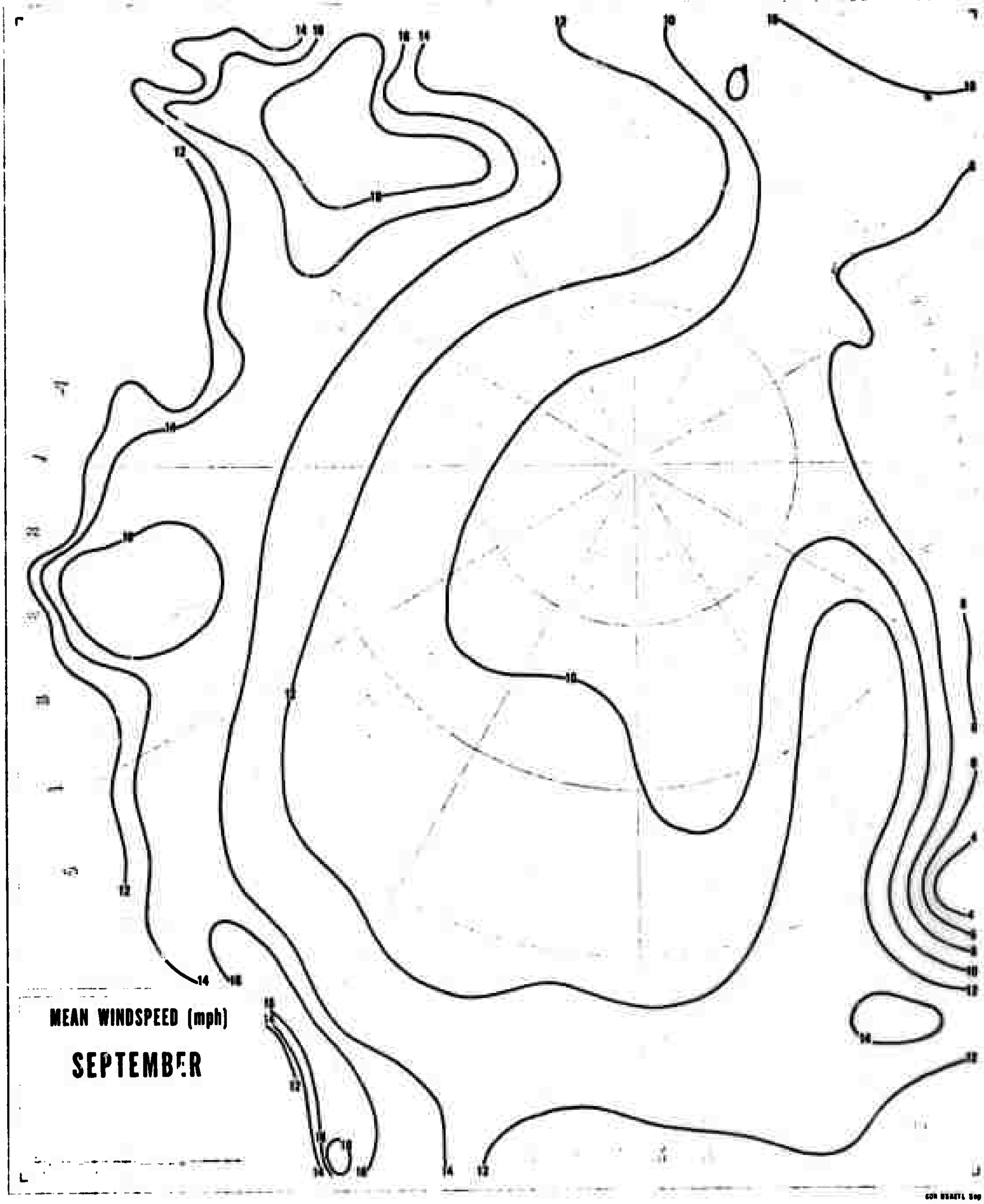
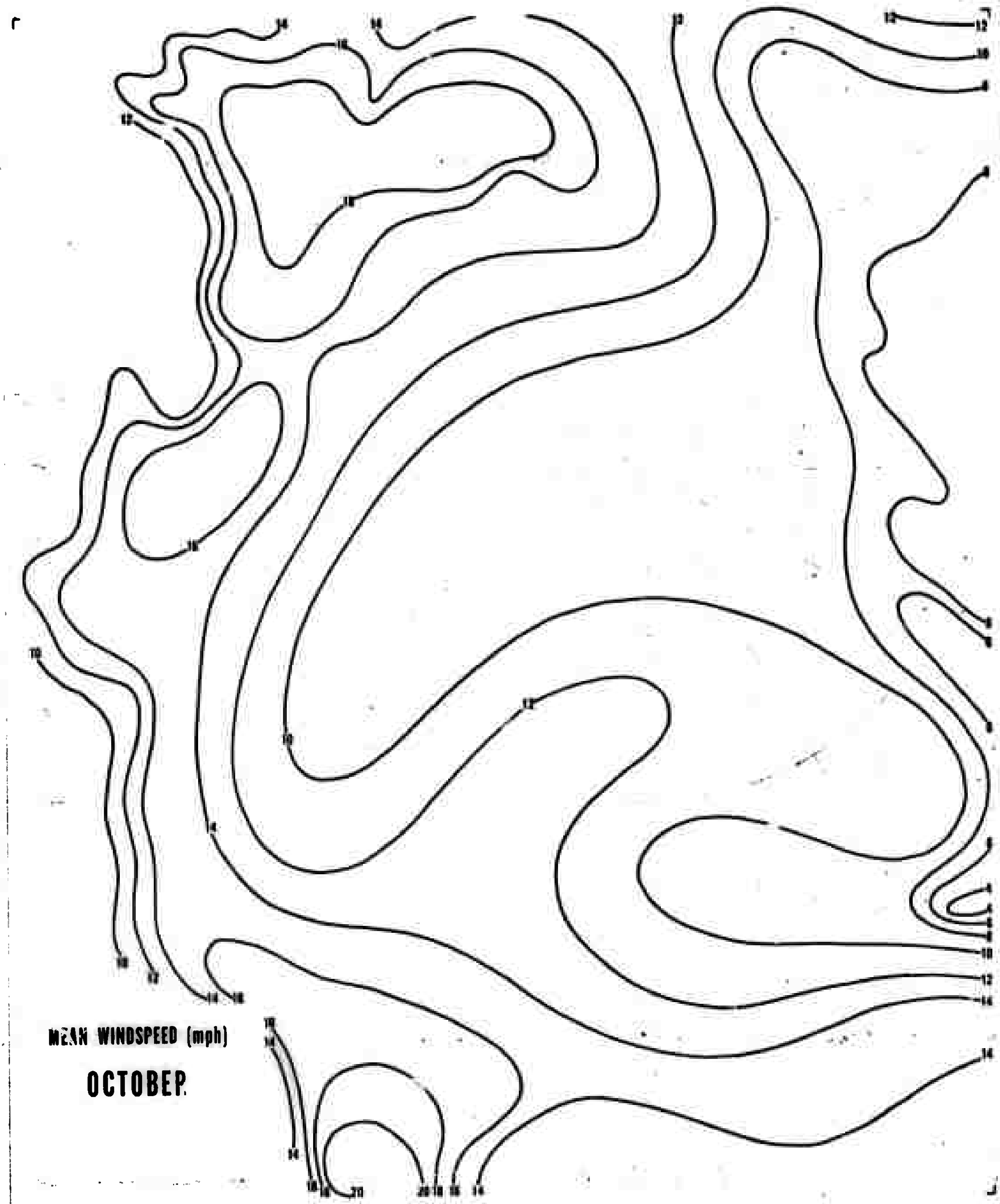
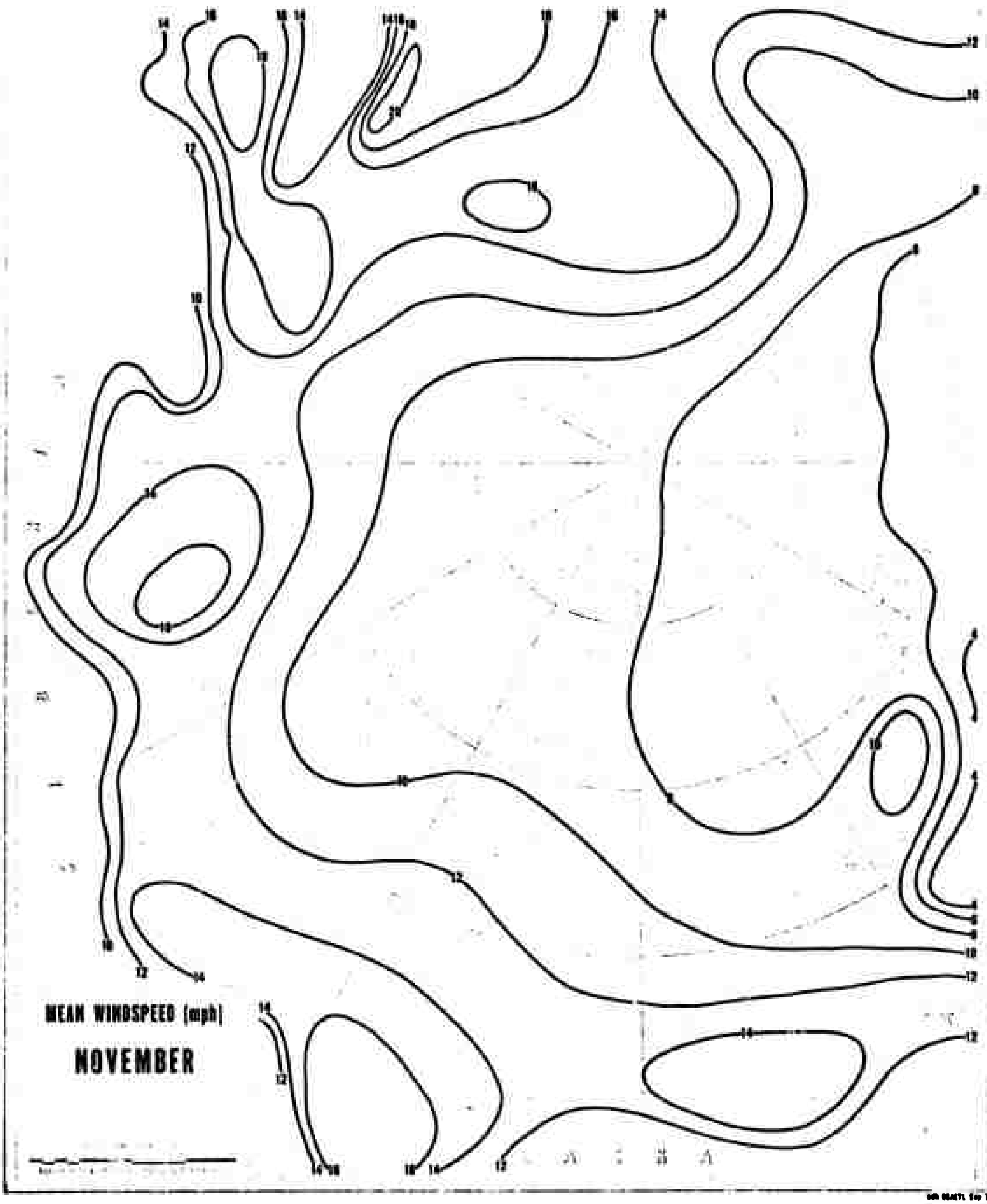


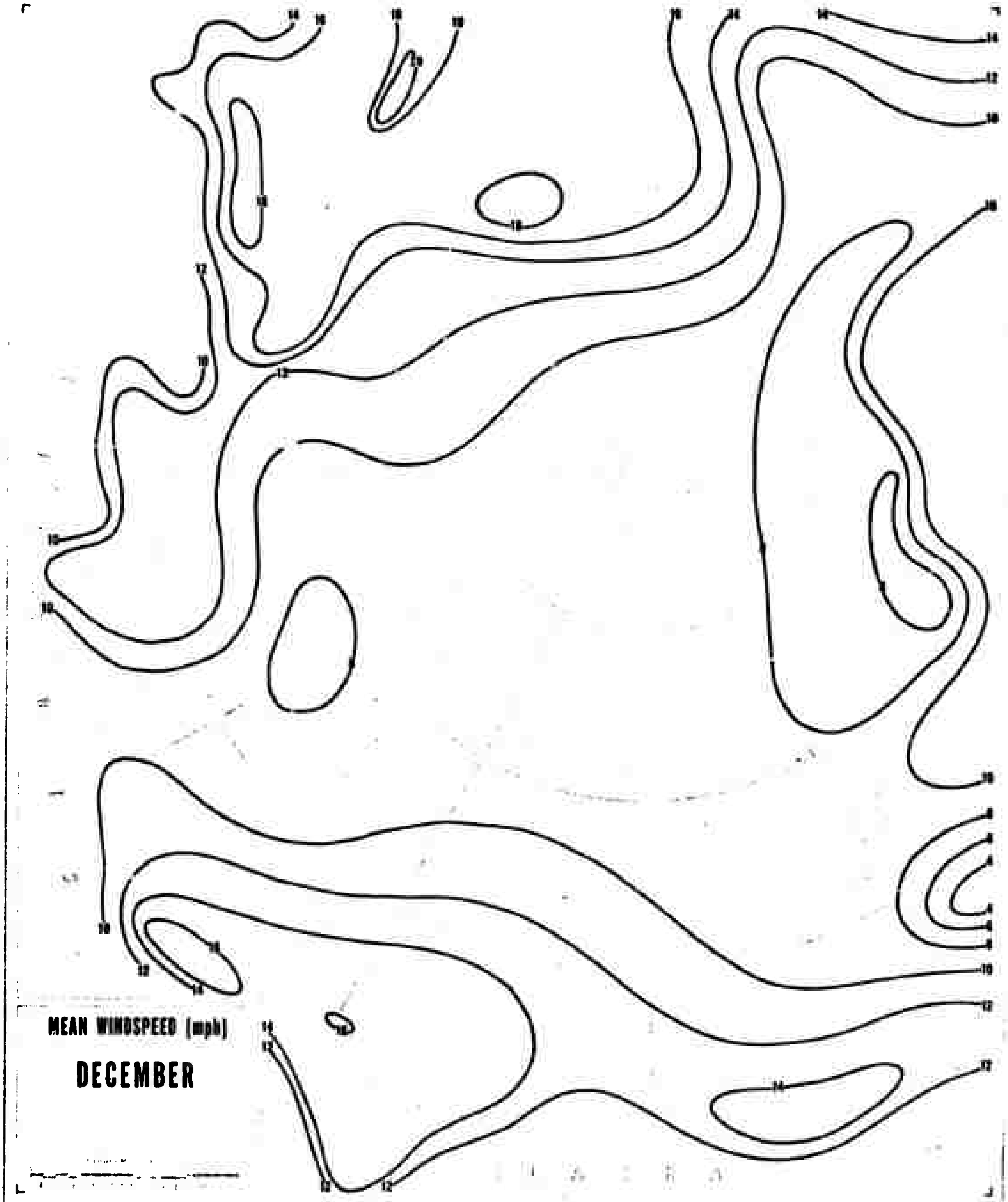
Fig. 10

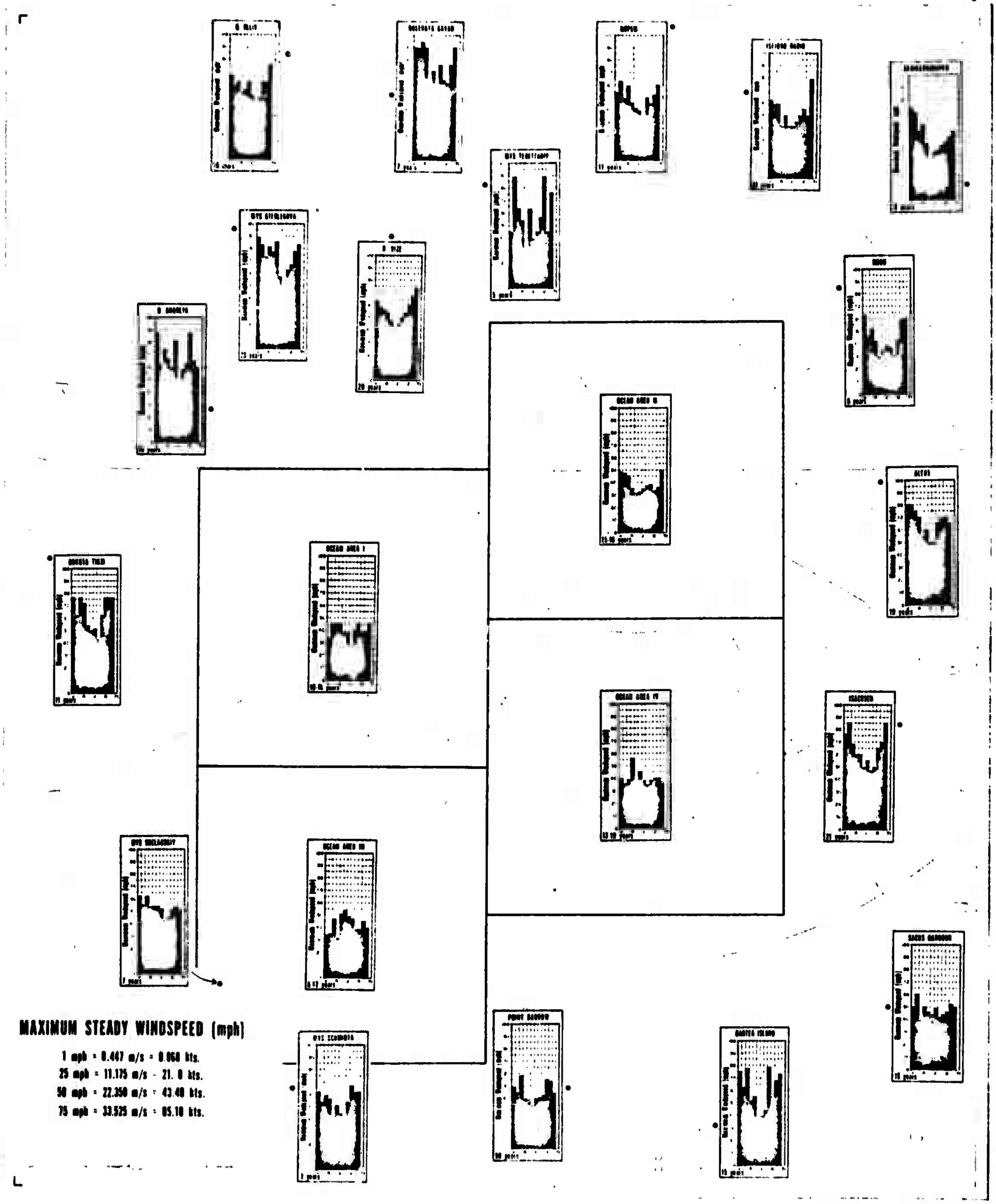


MEAN WINDSPEED (mph)

OCTOBER

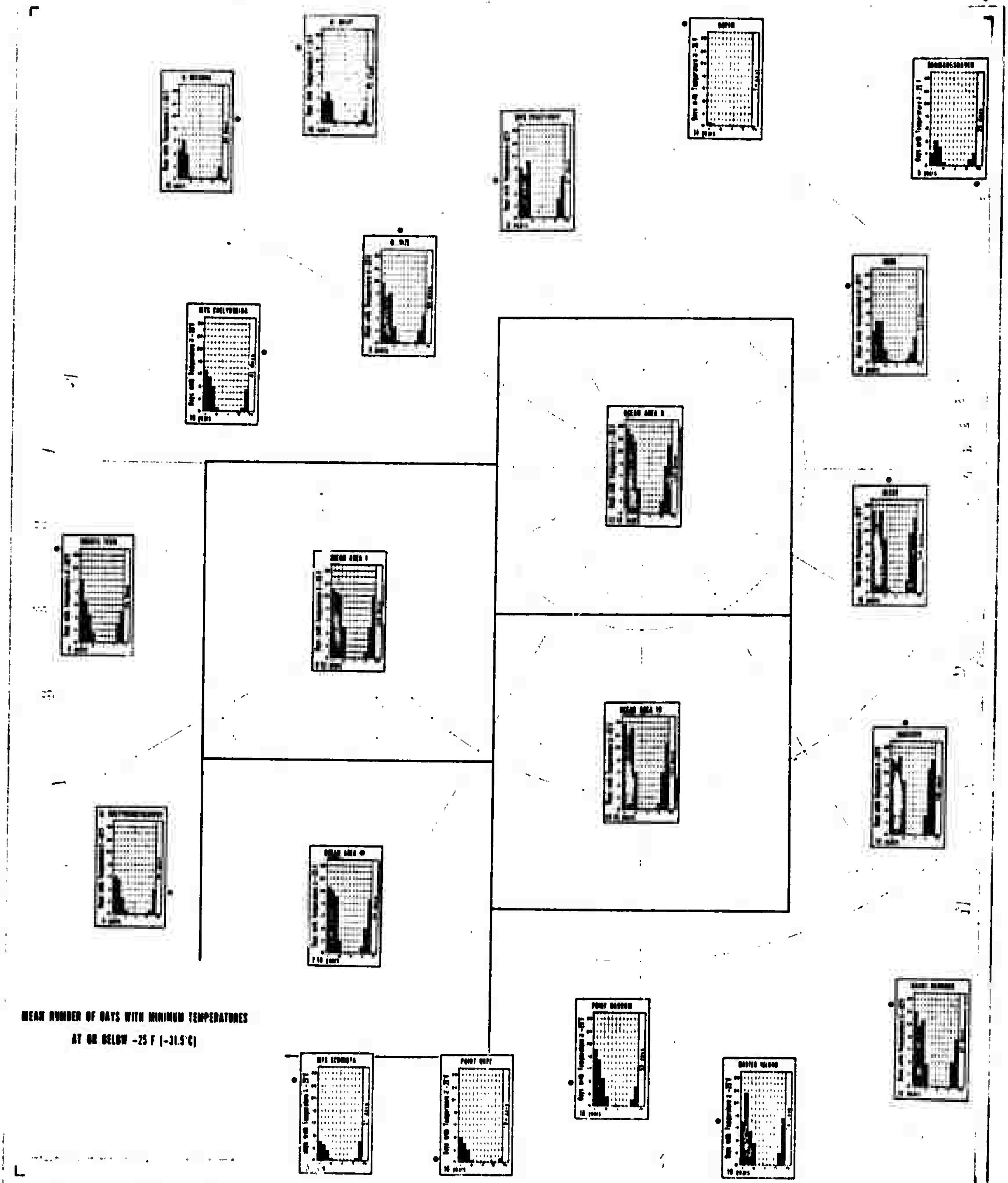

MEAN WINDSPEED (mph)
NOVEMBER


MEAN WINDSPEED (mph)
DECEMBER



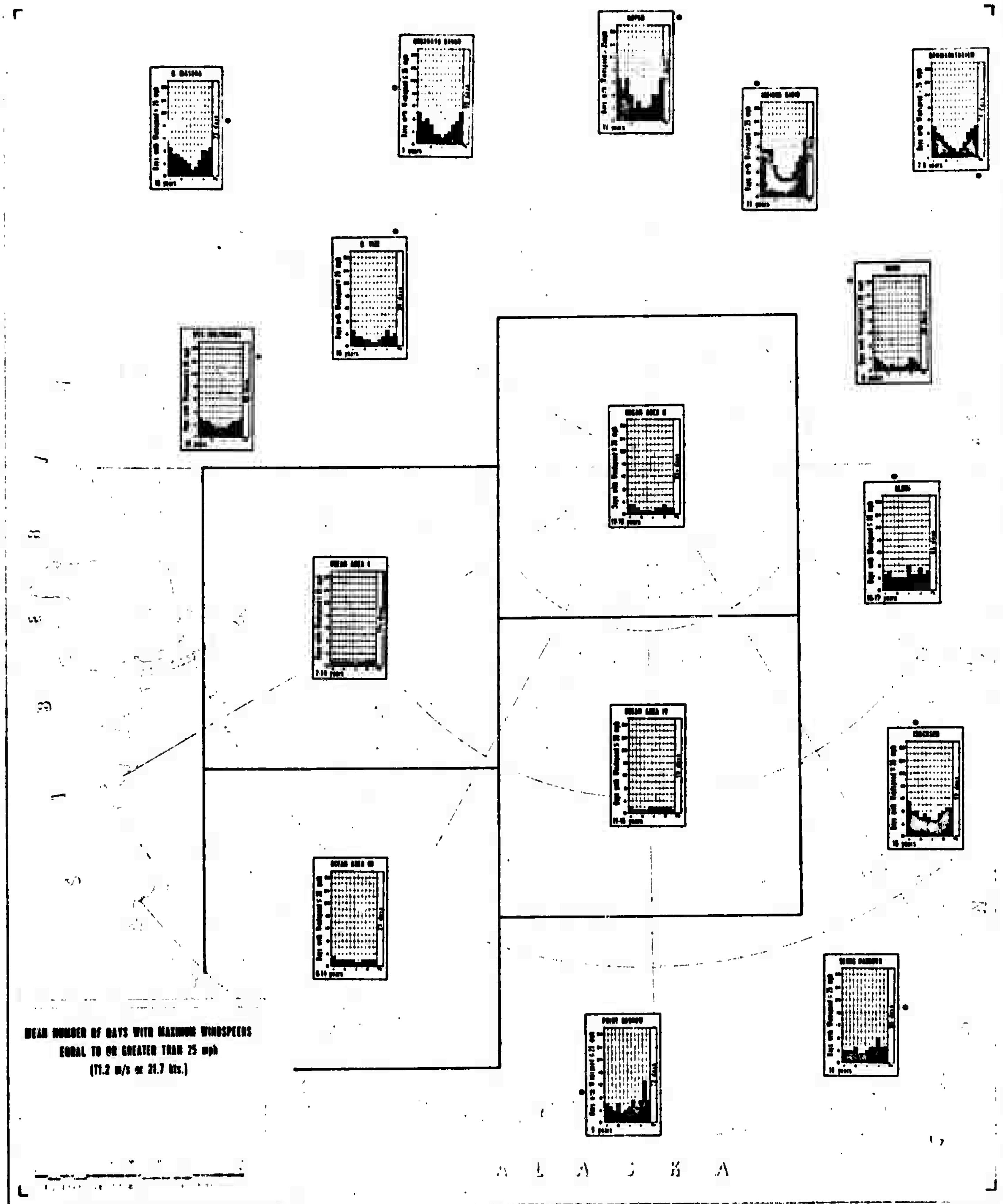
MAXIMUM STEADY WINDSPEED (mph)

1 mph = 0.447 m/s = 0.868 kts.
25 mph = 11.175 m/s = 21. 0 kts.
50 mph = 22.350 m/s = 43.40 kts.
75 mph = 33.525 m/s = 65.10 kts.

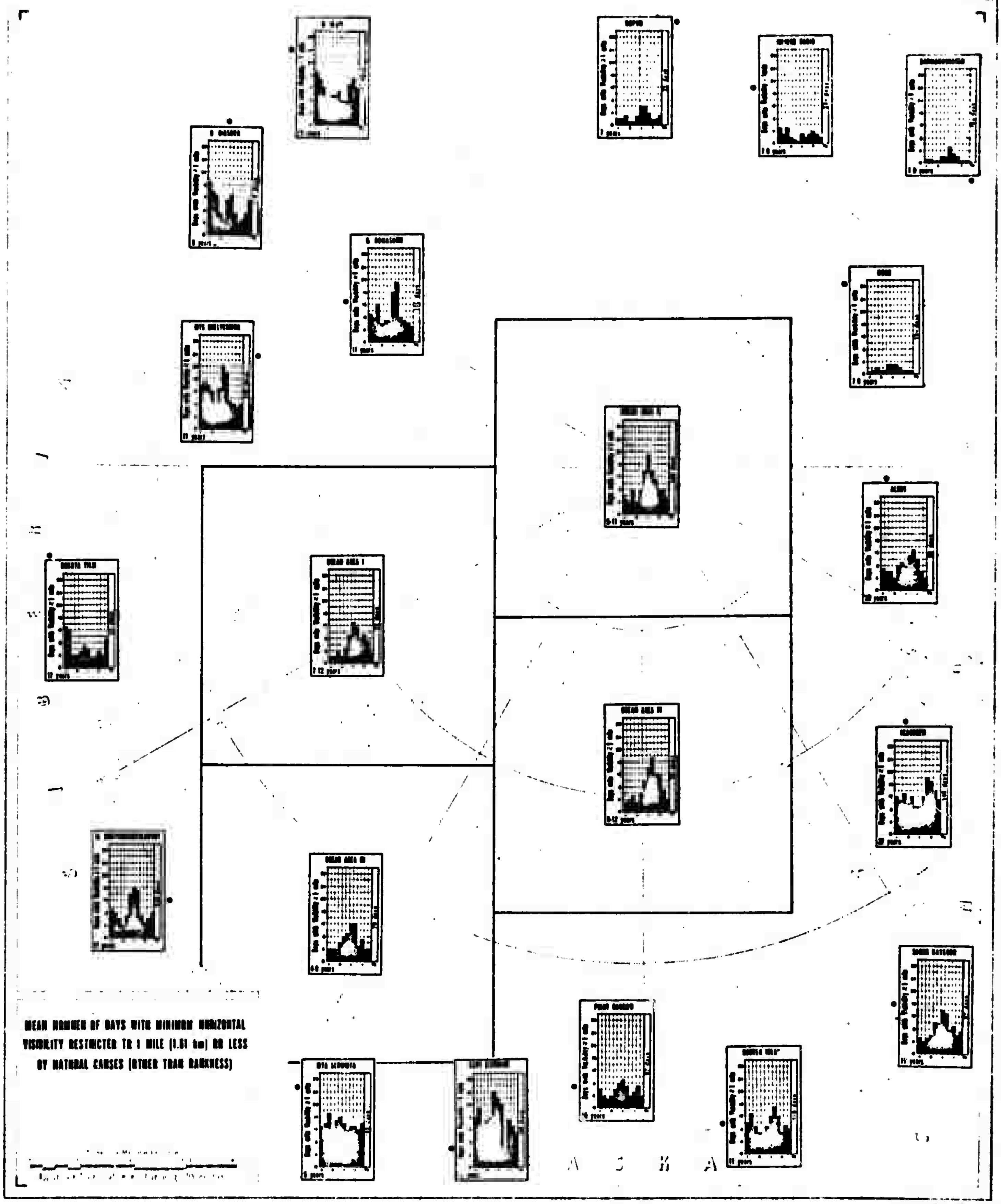


MEAN NUMBER OF DAYS WITH MINIMUM TEMPERATURES
AT OR BELOW -25 F (-31.5°C)

Fig. 84



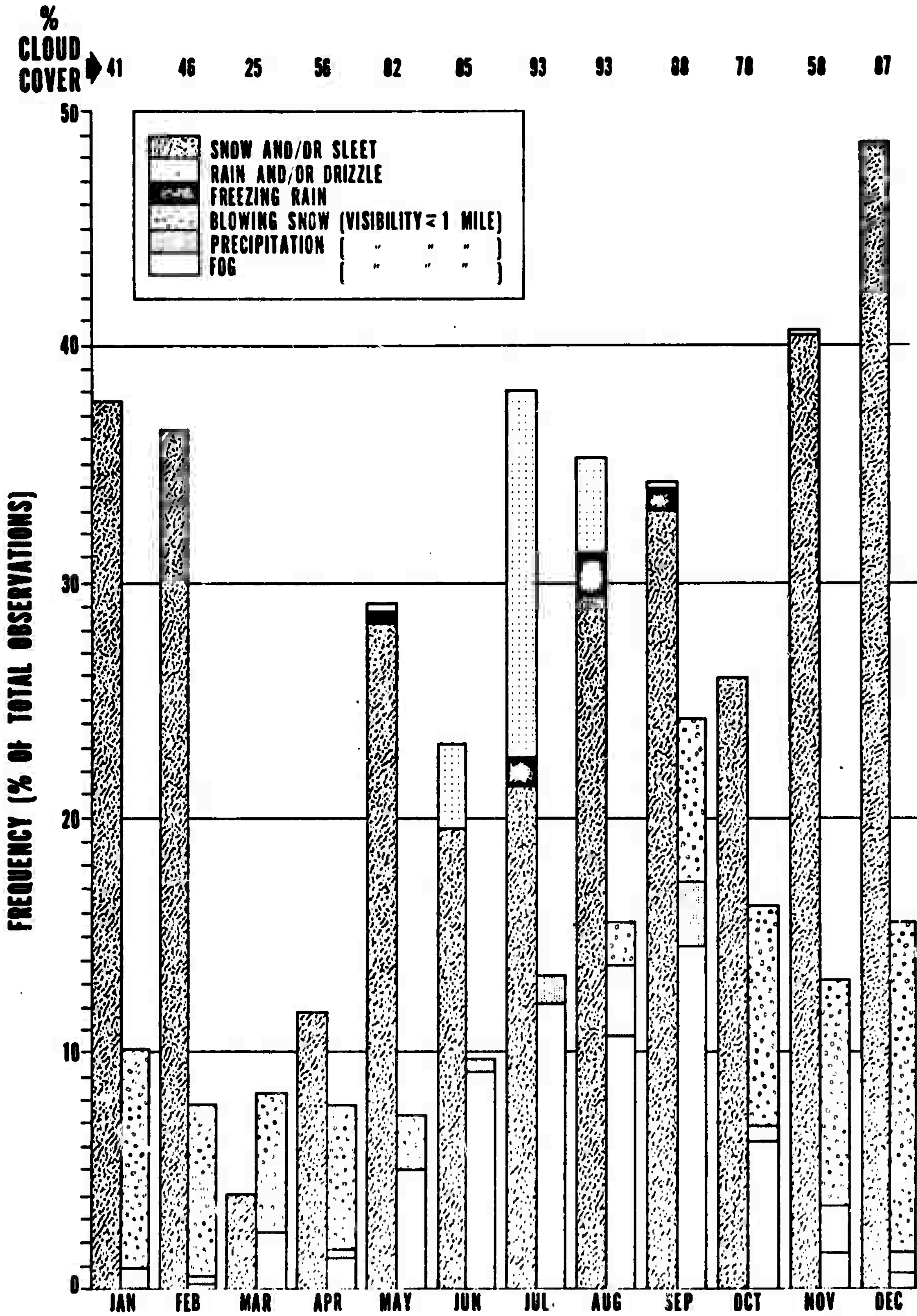
MEAN NUMBER OF DAYS WITH MAXIMUM WINDSPEEDS EQUAL TO OR GREATER THAN 25 mph (11.2 m/s or 21.7 kts.)



MEAN NUMBER OF DAYS WITH MINIMUM HORIZONTAL VISIBILITY RESTRICTED TO 1 MILE (1.61 km) OR LESS BY NATURAL CAUSES (OTHER THAN DARKNESS)

Fig. 66

PERCENT OCCURRENCE OF HYDROMETEORS NEAR THE NORTH POLE
(2 year means from T-3, Apr 1952 - Apr 1954)



adh USAETL Sep 71

7. Arctic Basin Temperatures During the Last Century.

We often read that older Arctic temperatures were markedly lower than those of recent times. While such statements may be quite true of certain years, usually at onshore stations (e.g. the Kane and Greely expeditions to North Greenland and Ellesmere), the findings of this study with respect to the Arctic Basin proper do not entirely substantiate such an opinion.

When the offshore data are compared in periods of two decades for the last century, the following observations emerge. Mean monthly temperatures of the winter and summer seasons prior to the 1930's look essentially like those of the long-term record. Likewise, every month of the year for the last two decades is virtually indistinguishable from the long-term counterpart. Spring periods (April and May) prior to 1951 were generally warmer than the long-term means, in some cases appreciably so. October is the most variable month owing to its greater frequency of storms. Although data are scarce, October seems to have been markedly warmer during the 1871-90 and 1911-30 periods and equally deviant on the cold side during the intervening period at the turn of the century.

Extreme minimum recorded temperatures are likewise not dominated by the older data. To the contrary, the lowest all-time temperatures for every month except March and June belong to the priod since 1954. Extreme maximum temperatures (record highs) are fairly evenly divided, on the monthly basis, between the pre-1900 and post-1955 data.

Notable deviations of mean monthly temperature are found in the data from "Sedov," "Sadko," and "NP-1" in the late 1930's when the entire cold season from November through April was significantly warmer than the long-term monthly record. All of this is inconclusive, however, due to the strong bias introduced by the volume of data, of which nearly 80 percent are from the last two decades. Still, the evidence suggests no valid reason to disregard the older data used in these map analyses.

Mean Temperature Comparisons in °F

PERIOD (No. of Months)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1871-1890 (2-4)	-28	-30	-28	-5	17	31	34	33	20	4	-11	-20
1891-1910 (4-5)	-28	-27	-20	-8	13	30	32	31	17	-5	-18	-22
1911-1930 (2-3)	-27	-22	-24	-7	10	29	32	32	20	6	-12	-22
1931-1950 (2-6)	-19	-20	-22	-8	12	28	32	29	17	2	-7	-14
1951-1970 (40-56)	-27	-29	-28	-14	11	28	32	29	17	-2	-16	-24
Long-term 1871-1970	-27	-28	-27	-12	11	28	32	29	17	-1	-15	-23

Extreme Temperatures of Record (°F)

MONTH	MAXIMA		MINIMA	
JAN	+28	NP-5, 1956/ARLIS-II, 1965	-62	T-3, 1964
FEB	+32	NP-5, 1956/ARLIS-II, 1965	-69	NP-4, 1955
MAR	+28	Nansen's Trek, 1896/T-3, 1960	-62	Fram, 1894
APR	+30	T-3, 1966	-47	T-3, 1958
MAY	+37	Nansen's Trek, 1896/T-3, 1961 & 64	-24	T-3, 1959
JUN	+41*	Jeannette, 1880/T-3, 1958	-9	Jeannette, 1881
JUL	+46*	Jeannette, 1880	+19	NP-6, 1956/NP-12, 1964
AUG	+41*	NP-13, 1964/NP-20, 1970	+3	T-3, 1969
SEP	+38	T-3, 1961	-24	NP-3, 1954
OCT	+38	T-3, 1959	-47	NP-16, 1970
NOV	+26*	Sedov, 1938/ARLIS-II, 1961	-54	NP-16, 1970
DEC	+31	ARLIS-II, 1964	-57	T-3, 1957

* It will be noted in Table I, Appendix B, that certain of the maxima given above have been exceeded by records from the ships, Tegetthoff and Fram. However, they were not, strictly speaking, within the Arctic Basin at those times.

JUN	+50	Tegetthoff, in 1873 in Barents Sea	AUG	+51	Fram, 1896 in harbor, Spitzbergen
JUL	+46	Tegetthoff, in 1873 in Barents Sea	NOV	+27	Tegetthoff, 1872 in Barents Sea

8. **Acknowledgments.**

The author is indebted to many persons for assistance in the data acquisition stages of this study. First acknowledgments go to colleagues in Earth Sciences Laboratory at Natick: Miss Pauline Riordan for the initial bibliographic search, Miss Janet Sanderson for extraction, tabulation and cartographic assistance, Mrs. Dorothy Taylor for data reduction, Mr. John Griffin and Miss Kristin Gill for final map drafting.

With apologies for possible omissions imposed by the confusion of scores of referred long distance phone calls, the following persons were of invaluable help in providing data or significantly aiding in the location of often obscure and widely dispersed data sources: Mrs. Georgia Hergnes, American Geographical Society, New York; Messrs. James Decoster and G. Potocsky, USAF Environmental Technical Applications Center, Asheville, N. C.; Dr. Robert Faylor, Arctic Institute of North America, Washington; Col. Joseph Fletcher, Rand Corporation (currently with Office of Polar Programs, National Science Foundation); Messrs. Raymond Gordon, Albert Tragolo, and Walter Wittman, U. S. Naval Oceanographic Office, Suitland, Md.; Mr. Arne Hanson, Office of Naval Research, Chicago; Mr. Wayne Hensley, USAF Air Weather Service, Asheville, N. C.; Mr. Robert Higgins, USAF 6th Weather Wing, L. G. Hanscom Field, Bedford, Mass.; Dr. Kenneth Hunkins, Lamont Geological Observatory, Palisades, N. Y.; Mr. Albert Karpovich, USAF Environmental Technical Applications Center, Washington, D. C.; Dr. Svenn Orvig, McGill University, Montreal; Mr. A. Delbert Peterson, USAF Environmental Technical Applications Center, Washington; Dr. Norbert Untersteiner, University of Washington, Seattle; and Commander Robert Vollmer, Office of Naval Research, Washington. In several cases, these specialists were kind enough to loan sole-source copies of original manuscript records compiled personally while serving as members of scientific expeditions, with permission to use the data in this study. More than half of the contributory data were acquired in this manner and through the excellent data retrieval system of USAF ETAC in Asheville. Thus, something less than 50 percent of the climatological information used is available through published sources.

In conclusion, the author is particularly grateful to Dr. Charles Keeler, U. S. Army Cold Regions Research & Engineering Laboratory, Hanover, N. H., for the opportunity to conduct an essentially library-type climatological study which could exploit so much heretofore unpublished material.

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APPENDIX A

INVENTORY OF ARCTIC OCEAN STATIONS FOR WHICH BOTH MEAN MONTHLY POSITIONS AND SOME MONTHLY METEOROLOGICAL DATA WERE AVAILABLE AND USED – Inclusive POR given

Period of Record in parentheses indicates some months were incomplete. . . . .
Records which are discontinuous are indicated by the letter "b"

Ships	Period of Meteorol. Record	
Fram (F. Nansen – Norwegian North Polar Exp.)	Oct 1893 – Aug 1896	(35) months
Jeannette (G. W. DeLong – US Navy Polar Exp.)	Sep 1879 – Jun 1881	(22) "
Maud (H.U. Sverdrup–Norwegian No. Polar Exp.)	Sep 1922 – Jul 1924	23 "
Sadko (Soviet icebreaker)	Oct 1937 – Jul 1938	10 "
Sedov (" ")	Nov 1937 – Dec 1939	26 "
Tegetthoff (Weyprecht/Payer–Austr/Hungar.)	Aug 1872 – Oct 1873	15 "
	Sub-total	(131 months)
Over-ice Treks		
British Trans-Arctic Expedition	Feb 1968 – Jun 1969	(17) "
Nansen's Sledge Journey	Mar 1895 – Jun 1896	(16) "
Drifting Ice		
Alpha (USA)	Jun 1957 – Nov 1958	(18) "
Arlis I (USA)	Sep 1960 – Mar 1961	7 "
Arlis II (USA)	Jul 1961 – Mar 1965	45 "
Charlie (USA)	Jun 1959 – Dec 1959	7 "
Northpole I (Severnyi polius (SP)-USSR)	May 1937 -- Jan 1938	(9) "
Northpole II "	Apr 1950 – Mar 1951	12 "
Northpole III "	Jul 1954 – Mar 1955	(9) "
Northpole III alt. "	Aug 1954 – Jul 1955 b	(10) "
Northpole IV "	Nov 1954 – Apr 1957	(30) "
Northpole V "	Apr 1955 – Mar 1956	12 "
Northpole VI "	May 1956 – Aug 1959	(30) "
Northpole VII "	May 1957 – Mar 1959	(23) "
Northpole VIII "	May 1959 – Apr 1961	(24) "
Northpole IX "	May 1960 – Mar 1961	11 "
Northpole X "	Nov 1961 – Apr 1964 b	(28) "
Northpole XI "	May 1962 – Apr 1963 b	(10) "
Northpole XII "	May 1963 – Dec 1964	20 "
Northpole XIII " (1965 missing)	May 1964 – Mar 1967 b	(23) "
Northpole XIV "	Jan 1966	1 "
Northpole XV "	Apr 1966 – Feb 1968	(23) "
Northpole XVI "	May 1968 – Dec 1970	32 " +
Northpole XVII "	Jun 1968 – Sep 1969	16 "
Northpole XVIII "	Nov 1968 – Dec 1970	26 " +
Northpole XIX "	Nov 1969 – Dec 1970	(14) " +
Northpole XX "	May 1970 – Dec 1970	8 " +
Fletcher's T-3 (USA)	Apr 1952 – Apr 1954	25 "
Fletcher's T-3 (USA)	May 1955 -- Sep 1955	5 "
Fletcher's T-3 BRAVO (USA)	Jul 1957 – Oct 1961	(52) "
Fletcher's T-3 (USA)	May 1962 – Oct 1964	30 "
Fletcher's T-3 (USA)	Jan 1965 -- Mar 1970 b	(59) "
	Sub-total	(619 months)
	TOTAL	782 months

Months of Data COUNT

Jan	=	57 (5)	Apr	=	51 (6)	Jul	=	67 (2)	Oct	=	61 (6)
Feb	=	56 (4)	May	=	60 (4)	Aug	=	65 (3)	Nov	=	63 (5)
Mar	=	56 (5)	Jun	=	63 (4)	Sep	=	64 (5)	Dec	=	64 (5)

APPENDIX B

SELECTED TEMPERATURE AND WINDSPEED TABLES FOR DRIFT STATIONS AND OVER-ICE TRAVERSES

Footnotes

M	=	missing data (too scanty or otherwise unavailable during data search)
( )	=	questionable data (some observations missing and poorly distributed)
+	=	record for NP-16, NP-18, NP-19, NP-20, & T-3 continues after 1970
[ ]	=	onshore record, Nansen's island camp at Cape Norway
*	=	data from alternate station, NP-3, after main station was abandoned
——	=	whole year of 1956 missing from the T-3 record

(Blank spaces indicate station inoperative.)

TABLE 1: Maximum Recorded Temperature (°F) – not mapped

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fram	1893										(9)	23	3
"	1894	-13	15	4	14	32	37	38	37	32	12	14	-6
"	1895	11	-4	-6	-2	28	35	36	35	34	13	11	-2
"	1896	2	22	27	26	36	39	37	(51)				
Jeannette	1879									35	31	24	16
"	1880	-22	-23	4	20	35	41	46	40	27	15	8	12
"	1881	6	16	M	M	M	27						
Maud	1922									35	24	19	14
"	1923	-14	26	0	15	26	38	38	36	32	20	2	-6
"	1924	-4	-10	-9	4	23	36	27					
Sadko	1937										23	20	18
"	1938	M	1	-1	20	26	36	36					
Sedov	1938	17	1	M	21	M	36	M	M	34	32	18	27
"	1939	7	-5	-4	4	27	34	38	35	30	31	26	23
Tegetthoff	1872								47	33	36	27	-2
"	1873	27	28	0	17	28	50	46	42	35	25		
B.T.A. Trek	1968		(-9)	16	3	32	36	37	36	32	21	1	5
"	1969	-13	-6	-20	19	32							
Nansen's Trek	1895			-11	-4	26	34	35	35	[40	11	11	13
"	1896	10	30	28	27]	37	(34)						
Alpha	1957						(35)	35	34	29	25	-1	-10
"	1958	3	-14	-5	6	27	37	38	37	33	20	1	
Arlis-I	1960									30	24	1	17
"	1961	18	-8	-15									
Arlis-II	1961							39	35	32	29	26	-1
"	1962	21	17	26	16	25	37	35	34	30	24	22	-1
"	1963	-4	-9	-7	11	33	40	41	35	28	15	6	8
"	1964	-9	-2	-4	10	28	38	35	36	33	18	11	31
"	1965	28	32	9									
Charlie	1959						37	36	36	33	31	13	10
Northpole-1	1937					(28)	34	36	34	26	22	17	23
"	1938	20											
Northpole-2	1950				18	30	34	38	33	31	25	9	-12
"	1951	0	2	-3									
Northpole-3	1954							M	36	32	30	7	7
"	1955	-15	-6	16	18*	30*	34*	34*					
Northpole-4	1954								M	M	M	(12)	19
"	1955	-13	-13	14	18	30	34	34	34	28	23	-8	-4
"	1956	14	16	-8	0	27	32	34	32	28	(7)	(21)	(25)
"	1957	(10)	(19)	(14)									
Northpole-5	1955				18	30	34	34	36	30	19	-8	-4
"	1956	28	32	7									
Northpole-6	1956					27	34	37	32	32	30	1	1
"	1957	M	M	M	M	M	M	36	34	30	32	9	-11
"	1958	9	-9	5	7	25	34	34	34	32	18	1	9
Northpole-7	1957					28	34	M	34	27	27	-2	(-13)
"	1958	9	-15	-8	7	19	34	37	34	34	14	1	3
"	1959	-13	-18	-8									
Northpole-8	1959						34	37	36	34	30	13	7
"	1960	8	12	-1	8	28	34	39	34	28	19	3	3
"	1961	4	-2	-16	15								
Northpole-9	1960					33	34	39	36	33	20	6	5
"	1961	-2	-2	-12									
Northpole-10	1961											(21)	14
"	1962	27	7	9	18	21	36	34	(32)	36	M	M	-2
"	1963	-2	1	-11	14	28	34	36	34	32	18	14	7
"	1964	-11	5	1	18								
Northpole-11	1962					25	36	37	36	25	M	M	-6
"	1963	9	-6	-13	(14)								

TABLE I (continued)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northpole-12	1963					34	34	(43)	32	30	9	10	7
"	1964	0	-13	-15	1	27	36	34	36	25	14	12	3
Northpole-13	1964					32	36	36	(41)	28	28	18	12
"	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-2	0	-15	12	25	34	36	34	32	9	7	21
"	1967	-6	-17	16									
Northpole-14	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-2											
Northpole-15	1966				(5)	28	32	34	36	25	23	7	10
"	1967	-4	-17	-6	23	19	34	34	32	32	21	3	12
"	1968	9	-4										
Northpole-16	1968					32	34	36	36	34	26	-8	0
"	1969	10	-11	3	18	28	36	34	34	32	23	12	0
"	1970	7	-6	-9	3	28	34	36	36	32	21	9	-2 +
Northpole-17	1968						37	39	36	32	23	3	-2
"	1969	5	5	-2	1	19	34	34	34	30			
Northpole-18	1968											3	10
"	1969	10	-11	-4	23	30	37	36	37	32	25	7	3
"	1970	12	-2	-8	9	36	36	41	36	32	19	16	0 +
Northpole-19	1969											1	0
"	1970	7	-4	-4	12	34	36	34	34	32	19	16	3 +
Northpole-20	1970					28	36	41	41	32	16	16	3 +
Fletcher's T-3	1952				22	30	34	36	34	26	13	2	0
"	1953	-2	-10	-14	17	33	36	36	33	32	12	15	-5
"	1954	-10	-16	-25	14	M	M	M	M	M	M	M	M
"	1955	M	M	M	M	23	35	36	36	29			
"	1957							42	37	28	18	4	-14
"	1958	19	-6	-2	-7	27	41	38	38	35	25	-5	5
"	1959	-7	0	-9	12	32	40	40	39	35	38	17	-1
"	1960	(-12)	30	28	29	34	39	40	35	34	32	2	23
"	1961	25	-4	3	(25)	37	39	39	35	38	35		
"	1962					32	39	37	34	28	18	1	0
"	1963	-5	-14	-14	6	29	34	38	33	27	10	5	-1
"	1964	-26	-26	-18	-2	37	36	37	37	26	22	M	M
"	1965	1	-6	9	18	30	36	37	35	31	28	25	3
"	1966	13	-6	-11	30	36	40	38	37	31	25	25	4
"	1967	2	2	3	28	32	37	35	34	31	26	5	-2
"	1968	15	-19	3	5	35	39	36	34	33	25	-2	3
"	1969	-7	-6	-14	13	22	35	34	34	30	18	M	M
"	1970	M	M	-8	M	M	M	M	M	M	M	M	M +

TABLE II: Mean Daily Maximum Temperature (°F)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fram	1893										1	-5	-14
"	1894	-26	-25	-28	0	18	32	34	33	22	0	-17	-25
"	1895	-22	-28	-26	-14	14	31	33	31	20	0	-16	-21
"	1896	-28	-22	7	5	17	32	34	(37)				
Jeannette	1879									(29)	(19)	(3)	(-3)
"	1880	(-31)	(-30)	(-12)	(2)	(23)	(35)	(37)	(37)	(24)	(12)	(-10)	(-18)
"	1881	(-22)	(-19)	(-33)									
Maud	1922									25	12	-6	-7
"	1923	-26	-9	-17	0	12	31	34	33	22	10	-7	-25
"	1924	-18	-23	-20	-4	14	31	33					
Sadko	1937										(19)	(7)	(-2)
"	1938	(-11)	(-12)	(-13)	(2)	(15)	(31)	(33)					
Sedov	1937											(8)	(-2)
"	1938	(-10)	(-12)	(-10)	(2)	(16)	(28)	(33)	(32)	(28)	(14)	(-1)	(-3)
"	1939	(-20)	(-16)	(-29)	(-7)	(12)	(30)	(34)	(31)	(19)	(6)	(-1)	(-10)
Tegetthoff	1872								(36)	(18)	(7)	(-8)	(-16)
"	1873	(-13)	(-24)	(-20)	(-1)	(23)	(36)	(39)	(36)	(27)	(6)		
B.T.A. Trek	1968-69	———insufficient data for estimations———											
Nansen's Trek	1895-96	———	———	———		"	" "	"	———	———	———	———	———
Alpha	1957						32	33	29	16	8	-14	-30
"	1958	-19	-28	-20	-14	12	31	35	33	16	-3	-12	
Arlis-I	1960									(25)	(4)	(-12)	(-15)
"	1961	(-16)	(-24)	(-27)									
Arlis-II	1961							35	33	28	9	-2	-15
"	1962	-14	-15	-10	1	13	32	34	31	21	6	-4	-20
"	1963	-33	-26	-32	-12	14	32	35	32	19	2	-8	-12
"	1964	-30	-28	-25	-13	8	31	33	31	18	1	-7	-9
"	1965	-16	5	-8									
Charlie	1959						(31)	(33)	(32)	(20)	(-1)	(-12)	(-20)
Northpole-1	1937					(16)	29	33	31	15	0	-5	-6
"	1938	-12											
Northpole-2	1950				-2	17	31	34	31	22	8	-12	-25
"	1951	-29	-25	-17									
Northpole-3	1954							(33)	(31)	(18)	(14)	(-13)	(-18)
"	1955	(-28)	(-28)	(-20)	(-7)*	(14)*	(31)*	(33)*					
Northpole-4	1954								M	M	M	(-5)	-15
"	1955	-24	-31	-21	-12	11	30	33	31	18	3	-22	-23
"	1956	-22	-18	-30	-13	10	(26)	(33)	(31)	(13)	(-2)	(-4)	(0)
"	1957	(-15)	(-17)	(-18)	(-13)								
Northpole-5	1955				(-7)	(14)	(30).	(33)	(32)	(20)	(5)	(-21)	(-22)
"	1956	(-12)	(-11)	(-23)									
Northpole-6	1956					19	28	32	29	(24)	(8)	(-11)	(-14)
"	1957	M	M	M	M	M	M	32	30	22	5	-9	-30
"	1958	-19	-22	-18	-13	11	30	32	32	20	-1	-21	-14
Northpole-7	1957					15	30	(33)	28	13	9	-18	-32
"	1958	-22	-30	-21	-17	9	29	33	32	16	-5	-13	-17
"	1959	-30	-33	-28									
Northpole-8	1959						30	33	31	20	6	-10	-19
"	1960	-23	-18	-15	-7	16	30	33	31	21	6	-12	-11
"	1961	-16	-25	-27	-8								
Northpole-9	1960					22	32	34	32	25	8	-7	-15
"	1961	-17	-28	-30									

TABLE II (continued)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northpole-10	1961											(-9)	(-20)
"	1962	(-15)	(-18)	(-13)	(-3)	10	28	32	28	23	M	M	-25
"	1963	-27	-27	-32	-9	12	31	33	29	20	-3	-15	-16
"	1964	-34	-29	-26	-15								
Northpole-11	1962					13	28	32	(31)	M	M	M	-25
"	1963	-31	-23	-28	(-7)								
Northpole-12	1963					17	30	34	29	21	-1	-9	-9
"	1964	-34	-34	-30	-13	9	28	33	32	17	4	-11	-23
Northpole-13	1964					16	30	34	33	20	5	-6	-27
"	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-27	-19	-29	-8	11	26	33	31	19	-9	-13	-15
"	1967	-27	-38	-22									
Northpole-14	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-24											
Northpole-15	1966				(-4)	11	27	32	32	15	-9	-13	-12
"	1967	-28	-34	-26	-9	14	28	33	30	25	3	-13	-22
"	1968	-19	-31										
Northpole-16	1968					20	30	33	32	23	4	-23	-22
"	1969	-26	-28	-25	-10	13	30	33	30	25	0	-17	-16
"	1970	-17	-26	-23	-14	14	27	32	31	17	-4	-14	-24 +
Northpole-17	1968						32	33	32	20	3	-15	-25
"	1969	-21	-20	-34	-17	6	29	32	30	19			
Northpole-18	1968											-11	-16
"	1969	-13	-24	-21	-2	(17)	32	31	32	27	2	-9	-14
"	1970	-16	-17	-21	-13	13	27	32	30	21	1	-6	-21 +
Northpole-19	1969											-15	(-15)
"	1970	-12	-15	(-15)	-10	18	28	32	30	23	5	-5	-20 +
Northpole-20	1970					17	31	33	31	22	1	-9	-17 +
Fletcher's T-3	1952				-5	22	30	33	31	18	5	-14	-22
"	1953	-23	-27	-33	-8	20	30	33	25	16	-5	-11	-20
"	1954	-29	-33	-39	-7	M	M	M	M	M	M	M	M
"	1955	M	M	M	M	6	30	34	31	15			
"	1957							35	31	15	3	-15	-34
"	1958	-17	-30	-25	-17	14	34	35	34	24	7	-19	-15
"	1959	-22	-17	-22	-4	18	33	36	34	29	12	-5	-17
"	1960	(-29)	-6	-7	1	25	34	35	33	25	12	-8	-16
"	1961	(-4)	-21	-14	(-1)	28	35	35	33	33	(25)		
"	1962					17	33	33	30	19	5	-8	-23
"	1963	-31	-26	-33	-11	11	28	33	29	19	-2	-10	-16
"	1964	-41	-41	-30	-18	11	32	34	33	18	1	M	M
"	1965	-26	-25	-18	-6	19	30	34	34	23	10	(-11)	(-21)
"	1966	(-22)	-24	-22	(-7)	(21)	34	34	32	22	0	-11	-13
"	1967	-21	-28	-23	-1	15	30	32	29	22	9	-15	-21
"	1968	-17	-34	-20	-9	16	33	34	32	20	3	-16	-21
"	1969	-26	-29	-32	-12	11	29	32	29	21	1	M	M
"	1970	M	M	-28	M	M	M	M	M	M	M	M	M +

TABLE III: Mean Temperature ($^{\circ}$F) – Not Mapped

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fram	1893										(-5)	-12	-20
"	1894	-32	-32	-35	-6	14	29	32	30	17	-8	-24	-31
"	1895	-29	-35	-31	-20	10	28	32	28	15	-6	-24	-27
"	1896	-35	-31	-2	-1	13	29	32	(36)				
Jeannette	1879									(26)	(9)	(-4)	(-9)
"	1880	(-36)	(-35)	(-21)	(-3)	(18)	(30)	(33)	(33)	(17)	(3)	(-16)	(-30)
"	1881	(-27)	(-24)	(-38)									
Maud	1922								(31)	22	7	-11	-13
"	1923	-31	-15	-22	-5	9	29	32	32	19	6	-13	-30
"	1924	-22	-28	-25	-9	11	29	31					
Sadko	1937										14	1	-8
"	1938	-15	-18	-18	-3	11	29	31					
Sedov	1937											2	-8
"	1938	-14	-18	-14	-3	12	26	31	30	25	9	-7	-9
"	1939	-24	-22	-34	-12	8	28	32	29	16	1	-7	-16
Tegetthoff	1872								33	15	2	-12	-22
"	1873	-19	-30	-25	-7	16	31	35	33	24	1		
B.T.A. Trek	1968		(-26)	-15	-17	14	27	34	30	18	0	-24	-33
"	1969	-35	-33	-38	-15	16							
Nansen's Trek	1895			(-34)	-21	11	30	32	29	[21	0	-11	-11
"	1896	-18	-11	-10	9]	17	(32)						
Alpha	1957						29	32	27	11	3	-18	-34
"	1958	-26	-33	-26	-19	8	29	33	32	12	-8	-13	
Arlis-I	1960									20	-1	-17	-20
"	1961	-21	-29	-32									
Arlis-II	1961							32	30	23	2	-10	-23
"	1962	-20	-22	-16	-5	9	29	31	28	17	0	-12	-28
"	1963	-39	-33	-38	-20	10	29	33	29	15	-4	-16	-21
"	1964	-36	-35	-30	-18	-4	27	31	29	14	-5	-17	-18
"	1965	-22	-9	-13									
Charlie	1959						30	32	30	18	-4	-14	-23
Northpole-1	1937					(14)	27	33	29	9	-6	-12	-12
"	1938	-18											
Northpole-2	1950				-9	13	30	32	29	17	2	-17	-29
"	1951	-34	-30	-21									
Northpole-3	1954							32	29	14	9	-18	-22
"	1955	-33	-33	-24	-11*	10*	29*	32*					
Northpole-4	1954								30	19	7	-10	-20
"	1955	-27	-34	-24	-15	8	28	32	30	16	-1	-24	-26
"	1956	-26	-23	-34	-16	9	24	31	30	(11)	(-8)	(-6)	(-3)
"	1957	(-22)	(-21)	(-22)	(-16)								
Northpole-5	1955				-11	10	28	31	31	16	0	-26	-26
"	1956	-17	-16	-26									
Northpole-6	1956					17	26	31	27	(22)	(5)	(-15)	(-16)
"	1957	M	M	M	M	M	M	32	29	18	1	-13	-34
"	1958	-24	-26	-23	-18	8	28	32	31	15	-7	-24	-20
"	1959	M	M	M	M	9	28	32	30				
Northpole-7	1957					13	28	(32)	27	10	5	-20	-35
"	1958	-27	-35	-25	-20	6	28	32	31	12	-11	-18	-22
"	1959	-33	-35	-30									
Northpole-8	1959					(15)	29	32	30	18	3	-12	-22
"	1960	-26	-20	-19	-10	14	28	32	29	18	4	-14	-17
"	1961	-21	-32	-30	-13								
Northpole-9	1960					17	29	32	30	21	1	-13	-22
"	1961	-24	-34	-33									

TABLE III (continued)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northpole-10	1961											(-11)	-23
"	1962	-17	-20	-15	-5	8	27	31	27	20	M	M	-27
"	1963	-31	-29	-36	-13	10	29	32	28	17	-6	-19	-20
Northpole-11	1962					10	27	31	(29)	(13)	M	M	-28
"	1963	-34	-27	-32	(-10)								
Northpole-12	1963					14	28	32	26	18	-5	-14	-14
"	1964	-37	-37	-33	-18	5	26	31	20	14	1	-15	-29
Northpole-13	1964					12	29	32	31	17	2	-10	-30
"	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-29	-23	-31	-12	8	24	32	30	16	-11	-15	-20
"	1967	-29	-40	-25									
Northpole-14	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-29											
Northpole-15	1966				(-7)	9	26	31	30	12	-12	-16	-16
"	1967	-32	-37	-29	-11	11	26	32	29	22	-2	-16	-21
"	1968	-22	-33										
Northpole-16	1968					17	28	32	31	20	1	-27	-25
"	1969	-29	-30	-28	-14	10	28	31	28	22	-4	-20	-19
"	1970	-21	-28	-27	-18	12	25	31	30	13	-10	-20	-29 +
Northpole-17	1968						29	32	30	17	-2	-20	-29
"	1969	-26	-25	-39	-20	5	27	31	28	15			
Northpole-18	1968											-14	-20
"	1969	-17	-27	-25	-6	(13)	30	30	30	23	-2	-13	-17
"	1970	-19	-21	-23	-16	12	26	31	29	18	-4	-12	-25 +
Northpole-19	1969											-18	(-18)
"	1970	-16	-18	(-18)	-14	16	27	31	29	19	1	-9	-22 +
Northpole-20	1970					14	28	31	30	19	-4	-12	-21 +
Fletcher's T-3	1952				-9	20	28	32	30	14	1	-18	-26
"	1953	-27	-32	-36	-12	18	28	32	23	12	-10	-16	-24
"	1954	-34	-38	-42	-12	M	M	M	M	M	M	M	M
"	1955	M	M	M	M	2	28	32	30	11			
"	1957							34	28	11	-1	-21	-39
"	1958	-22	-35	-31	-23	9	30	33	32	19	0	-25	-22
"	1959	-28	-24	-30	-15	10	28	32	32	26	6	-12	-24
"	1960	(-32)	-12	-14	-6	20	30	32	30	20	8	-14	-10
"	1961	(-9)	-28	-20	(-8)	21	32	32	31	31	(22)		
"	1962					15	32	32	28	17	2	-12	-27
"	1963	-34	-29	-35	-16	8	26	32	26	14	-6	-16	-22
"	1964	-44	44	-34	-22	8	30	32	30	12	-4	M	M
"	1965	-31	-30	-22	-10	11	25	33	31	18	4	(-14)	-26
"	1966	-27	-29	-28	-11	14	32	33	31	19	-7	-16	-18
"	1967	-26	-33	-29	-7	13	28	31	28	19	4	-21	-25
"	1968	-21	-38	-26	-13	12	29	32	30	13	-4	-22	-28
"	1969	-32	-35	-38	-18	7	26	31	26	14	-8	M	M
"	1970	M	M	-33	M	M	M	M	M	M	M	M	M +

TABLE IV: Mean Daily Minimum Temperature (°F)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fram	1893										(-11)	-18	-26
"	1894	-38	-40	-41	-15	9	26	31	27	10	-17	-30	-37
"	1895	-35	-41	-37	-26	5	24	29	23	9	-6	-30	-32
"	1896	-41	-37	-12	-8	7	26	30	(34)				
Jeannette	1879									(22)	(0)	(-12)	(-18)
"	1880	(-42)	(-39)	(-31)	(-8)	(13)	(25)	(29)	(30)	(10)	(-11)	(-21)	(-34)
"	1881	(-33)	(-29)	(-42)									
Maud	1922									19	3	-15	-18
"	1923	-34	-21	-28	-12	4	27	30	30	15	0	-18	-34
"	1924	-26	-33	-30	-12	8	26	29					
Sadko	1937										(9)	(-4)	(-13)
"	1938	(-19)	(-23)	(-24)	(-9)	(7)	(26)	(29)					
Sedov	1937											(-3)	(-13)
"	1938	(-18)	(-23)	(-20)	(-9)	(8)	(22)	(29)	(28)	(21)	(4)	(-12)	(-14)
"	1939	(-28)	(-27)	(-40)	(-18)	(4)	(25)	(30)	(27)	(12)	(-4)	(-12)	(-21)
Tegetthoff	1872								(30)	(12)	(-3)	(-17)	(-28)
"	1873	(-25)	(-37)	(-30)	(-13)	(9)	(27)	(31)	(30)	(21)	(-4)		
B.T.A. Trek	1968-69	---------------------insufficient data for estimations---------------------											
Nansen's Trek	1895-96	----------------------				"	"	"	"	--------------------			
Alpha	1957						27	31	24	6	-2	-21	-38
"	1958	-31	-38	-31	-23	4	28	31	31	7	-13	-18	
Arlis-I	1960									(15)	(-6)	(-22)	(-25)
"	1961	(-26)	(-34)	(-37)									
Arlis-II	1961							29	27	17	-5	-20	-32
"	1962	-26	-29	-22	-11	4	25	28	25	10	-8	-22	-36
"	1963	-45	-40	-43	-24	5	25	30	24	7	-13	-26	-31
"	1964	-42	-42	-38	-25	-1	24	27	27	8	-12	-25	-25
"	1965	-28	-20	-24									
Charlie	1959						(29)	(31)	(28)	(16)	(-7)	(-17)	(-26)
Northpole-1	1937					(11)	25	31	27	3	-14	-19	-19
"	1938	-25											
Northpole-2	1950				-14	10	29	30	28	13	-3	22	-33
"	1951	-38	-35	-24									
Northpole-3	1954							(31)	(27)	(10)	(4)	(-23)	(-27)
"	1955	(-38)	(-38)	(-28)	(-15)*	(7)*	(28)*	(30)*					
Northpole-4	1954								M	M	M	(-15)	-27
"	1955	-29	-38	-27	-19	6	27	30	29	13	-5	-28	-30
"	1956	-33	-27	-39	-18	6	(22)	(29)	(29)	(8)	(-11)	(-9)	(-7)
"	1957	(-31)	(-25)	(-26)	(-19)								
Northpole-5	1955				(-15)	(7)	(27)	(30)	(29)	(12)	(-5)	(-31)	(-31)
"	1956	(-22)	(-21)	(-30)									
Northpole-6	1956					14	25	29	26	(21)	(0)	(-17)	(-20)
"	1957	M	M	M	M	M	M	30	27	15	-4	-17	-37
"	1958	-30	-30	-28	-23	5	27	31	29	11	-13	-28	-26
Northpole-7	1957					11	27	(31)	25	5	0	-23	-38
"	1958	-32	-39	-28	-23	4	26	31	29	6	-16	-22	-27
"	1959	-36	-38	-31									
Northpole-8	1959						28	30	28	15	-1	-16	-24
"	1960	-28	-23	-23	-12	12	26	31	27	17	-1	-18	-21
"	1961	-32	-38	-33	-17								
Northpole-9	1960					10	26	30	27	14	-6	-19	-28
"	1961	-30	-38	-36									

TABLE IV (continued)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northpole-10	1961											(-13)	-26
"	1962	-19	-22	-17	-7	6	26	30	26	17	M	M	-29
"	1963	-35	-31	-40	-17	8	27	31	27	14	-9	-23	-24
"	1964	-42	-29	-36	-21								
Northpole-11	1962					7	26	30	(27)	M	M	M	-31
"	1963	-37	-31	-35	(-13)								
Northpole-12	1963					11	26	30	23	15	-9	-19	-19
"	1964	-40	-40	-36	-23	1	24	29	28	11	-2	-19	-35
Northpole-13	1964					8	28	30	29	14	-1	-14	-33
"	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-31	-27	-33	-16	5	22	31	29	13	-13	-17	-25
"	1967	-33	-42	-28									
Northpole-14	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-35											
Northpole-15	1966				(-10)	7	25	30	28	9	-15	-19	-20
"	1967	-36	-40	-32	-13	8	24	31	28	19	-7	-20	-23
"	1968	-25	-35										
Northpole-16	1968					14	26	31	30	17	-2	-31	-28
"	1969	-32	-32	-31	-18	7	26	29	26	19	-8	-23	-22
"	1970	-25	-30	-31	-22	10	23	30	29	9	-16	-26	-34 +
Northpole-17	1968						26	31	28	14	-7	-25	-33
"	1969	-31	-30	-44	-23	4	25	30	26	11			
Northpole-18	1968											-17	-24
"	1969	-21	-30	-29	-10	(9)	28	29	28	(18)	-6	-17	-20
"	1970	-22	-25	-25	-19	11	25	30	28	15	-9	-18	-28 +
Northpole-19	1969											-21	(-21)
"	1970	-20	-21	(-21)	-18	13	26	(30)	28	15	-3	-13	-24 +
Northpole-20	1970					11	25	29	29	16	-9	-15	-25 +
Fletcher's T-3	1952				-13	17	27	31	28	9	-3	-22	-30
"	1953	-31	-36	-40	-16	15	27	31	21	7	-16	-22	-29
"	1954	-40	-43	-45	-16	M	M	M	M	M	M	M	M
"	1955	M	M	M	M	-1	27	31	28	7			
"	1957							32	26	8	-7	-26	-43
"	1958	-28	-41	-37	-28	3	26	30	30	14	-6	-31	-27
"	1959	-35	-32	-38	-26	1	24	30	29	23	-1	-18	-30
"	1960	(-35)	-18	-20	-12	15	27	30	28	15	3	-19	-16
"	1961	(-14)	-34	-26	(-14)	14	29	28	29	30	(19)		
"	1962					13	30	31	27	15	-1	-15	-31
"	1963	-37	-32	-37	-20	6	25	31	23	8	-10	-23	-29
"	1964	-47	-47	-39	-27	4	28	30	28	7	-8	M	M
"	1965	-36	-35	-26	-18	3	21	32	27	12	-4	(-19)	(-31)
"	1966	(-32)	-35	-33	(-24)	(7)	31	31	29	14	-13	-21	-24
"	1967	-31	-38	-34	-12	10	27	30	26	16	-1	-27	-30
"	1968	-26	-43	-30	-18	8	25	31	27	6	-12	-28	-35
"	1969	-39	-41	-43	-24	3	24	29	24	6	-17	M	M
"	1970	M	M	-39	M	M	M	M	M	M	M	M	M +

TABLE V: Minimum Recorded Temperature (°F)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fram	1893										(-20)	-30	-37
"	1894	-44	-58	-62	-37	-6	14	26	18	-11	-34	-44	-48
"	1895	-59	-51	-44	-37	-15	12	26	17	-15	-22	-47	-50
"	1896	-58	-54	-46	-30	-19	19	27	(29)				
Jeannette	1879									7	-17	-24	-26
"	1880	-57	-50	-53	-24	-8	19	26	26	0	-14	-33	-48
"	1881	-50	-42	-45	-26	-12	-9						
Maud	1922									2	-11	-30	-28
"	1923	-46	-37	-37	-24	-5	13	26	26	-3	-13	-29	-41
"	1924	-36	-46	-43	-24	-4	12	24					
Sadko	1937										(1)	-33	-32
"	1938	-35	-44	-30	-29	-4	19	26					
Sedov	1938	M	-44	M	M	M	M	M	M	13	-15	-32	-38
"	1939	-46	-39	-47	-35	-9	18	26	19	-8	-25	-40	-41
Tegetthoff	1872								19	-10	-28	-32	-32
"	1873	-47	-51	-44	-38	-9	13	28	22	4	-20		
B.T.A. Trek	1968		(-42)	-44	-42	-18	16	30	23	-8	-29	-38	-47
"	1969	-47	-53	-53	-38	-6	(16)						
Nansen's Trek	1895			-51	-37	-12	19	28	19	[-4	-13	-33	-36
"	1896	-42	-35	-26	-13]	-8	(21)						
Alpha	1957						(19)	23	11	-23	-23	-30	-57
"	1958	-57	-45	-51	-38	-9	13	(30)	24	-16	-31	-25	
Arlis-I	1960									5	-22	-33	-35
"	1961	-38	-49	-47									
Arlis-II	1961							26	20	4	-29	-38	-44
"	1962	-54	-42	-36	-29	-13	10	27	14	-9	-29	-42	-51
"	1963	-61	-50	-57	-40	-5	11	23	16	-14	-38	-44	-42
"	1964	-55	-54	-51	-45	-13	13	22	16	-8	-27	-40	-47
"	1965	-54	-38	-38									
Charlie	1959						22	26	19	-8	-26	-38	-43
Northpole-1	1937					(2)	18	28	14	-18	-32	-32	-33
"	1938	-47											
Northpole-2	1950				-28	-7	20	23	20	-3	-23	-35	-43
"	1951	-57	-48	-42									
Northpole-3	1954							M	16	-24	-22	-36	-49
"	1955	-45	-47	-45	-35*	-4*	18*	28*					
Northpole-4	1954								M	M	M	(-31)	-53
"	1955	-42	-69	-40	-31	-8	19	25	23	-15	-20	-42	-44
"	1956	-53	-42	-58	-31	-8	16	28	25	(-15)	(-26)	(-27)	(-36)
"	1957	-60	(-38)	(-49)	(-33)								
Northpole-5	1955				-31	-4	18	28	25	3	-20	-36	-45
"	1956	-53	-47	-56									
Northpole-6	1956					-4	10	19	18	7	(-17)	(-35)	(-45)
"	1957	M	M	M	M	M	M	25	19	-4	-26	-29	-54
"	1958	-54	-40	-36	-35	-6	16	28	16	-8	-35	-40	-40
Northpole-7	1957					-8	19	M	14	-22	-22	-36	-56
"	1958	-51	-45	-42	-40	-8	12	28	23	-17	-42	-36	-40
"	1959	-51	-56	-47									
Northpole-8	1959						21	26	19	-4	-29	-40	-40
"	1960	-44	-44	-47	-31	-4	19	30	19	-2	-15	-51	-36
"	1961	-43	-53	-47	-30								
Northpole-9	1960					-7	22	26	17	-7	-17	-38	-35
"	1961	-40	-59	-52									

TABLE V (continued)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northpole-10	1961											(-35)	-53
"	1962	-36	-38	-31	-24	-13	16	25	(18)	1	M	M	-47
"	1963	-49	-44	-51	-35	-8	23	28	18	-6	-29	-42	-44
"	1964	-51	-44	-49	-44								
Northpole-11	1962					-11	16	28	14	3	M	M	-51
"	1963	-51	-40	-51	(-38)								
Northpole-12	1963					-8	14	27	10	-11	-22	-29	-35
"	1964	-56	-58	-51	-42	-15	10	19	19	-8	-22	-31	-54
Northpole-13	1964					-11	10	25	25	-11	-18	-31	-53
"	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-44	-38	-44	-33	-17	9	27	19	-8	-42	-36	-53
"	1967	-51	-49	-49									
Northpole-14	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-35											
Northpole-15	1966				(-22)	-13	14	27	16	-9	-40	-33	-35
"	1967	-51	-54	-53	-26	0	10	30	23	-6	-26	-38	-38
"	1968	-44	-47										
Northpole-16	1968					-13	18	27	25	0	-22	-40	-44
"	1969	-44	-42	-49	-38	-11	12	21	14	3	-33	-36	-35
"	1970	-40	-42	-49	-35	-13	9	27	18	-6	-47	-54	-51 +
Northpole-17	1968						16	27	21	-2	-31	-45	-56
"	1969	-51	-51	-54	-38	-8	12	28	14	-9			
Northpole-18	1968											-27	-45
"	1969	-36	-42	-45	-29	-8	9	23	23	10	-18	-27	-40
"	1970	-40	-38	-35	-38	-11	10	25	18	-8	-24	-44	-47 +
Northpole-19	1969											-29	-27
"	1970	-36	-36	-31	-35	1	14	28	18	-4	-20	-42	-45 +
Northpole-20	1970					-22	14	25	18	-2	-24	-42	-47 +
Fletcher's T-3	1952				-32	5	19	28	17	-4	-32	-46	-40
"	1953	-43	-50	-55	-40	-2	20	26	9	-17	-35	-38	-46
"	1954	-53	-60	-55	-43	M	M	M	M	M	M	M	M
"	1955	M	M	M	M	-15	23	24	18	-15			
"	1957							29	15	-17	-35	-50	-57
"	1958	-61	-64	-51	-47	-10	9	27	25	-7	-33	-42	-46
"	1959	-55	-43	-54	-39	-24	13	24	24	5	-25	-27	-42
"	1960	(-43)	-41	-42	-32	-4	20	28	21	-2	-16	-33	-37
"	1961	(-33)	-41	-42	(-28)	2	23	24	25	27	(11)		
"	1962					-1	17	28	8	2	-22	-32	-46
"	1963	-55	-42	-58	-46	-15	13	26	6	-16	-24	-44	-40
"	1964	-62	-58	-54	-46	-12	21	26	17	-22	-31	M	M
"	1965	-51	-51	-47	-38	-13	8	27	11	-9	-20	-26	-45
"	1966	-53	-45	-44	-40	-12	24	24	19	-9	-37	-39	-43
"	1967	-61	-56	-51	-37	-1	9	26	15	-2	-26	-43	-44
"	1968	-52	-55	-52	-31	-14	17	29	18	-6	-36	-37	-50
"	1969	-52	-61	-56	-38	-18	8	26	3	-14	-32	M	M
"	1970	M	M	-58	M	M	M	M	M	M	M	M	M +

TABLE VI: Mean Dewpoint Temperatures (°F)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fram	1893										(-8)	-15	-22
"	1894	-34	-33	-39	-9	10	26	30	28	14	-13	-29	-36
"	1895	-35	-39	-34	-24	7	26	31	26	12	-41	-25	-31
"	1896	-38	-33	-4	-5	9	27	31	(33)				
Maud	1922									21	6	-14	M
"	1923	M	M	M	M	8	28	31	31	17	3	-17	-32
"	1924	M	M	M	M	7	27	30					
Alpha	1957						27	31	25	11	3	-18	-34
"	1958	-26	-40	-33	-26	6	27	32	31	12	-9		
Northpole-1	1937						25	32	28	6	-10	-17	-15
"	1938	-23											
Northpole-2	1950				-15	11	28	31	28	14	-4	-23	-35
"	1951	-40	-36	-25									
Northpole-3	1954								(28)	(12)	(5)	(-22)	(-26)
"	1955	(-37)	(-37)	(-27)	M	(9)*	(27)*	(30)*					
Northpole-4	1954											-14	-25
"	1955	-32	-40	-29	-19	3	26	30	29	13	-5	-28	-30
"	1956	-29	-29	-36	-20	7	(22)	(30)	(28)	(8)	(-13)	(-9)	(-6)
"	1957	(-27)	(-22)	(-27)	(-26)								
Northpole-6	1956					14	24	30	26	20	1	-17	-19
"	1957	M	M	M	M	M	M	31	27	16	-2	-15	-37
"	1958	-27	-29	-25	-20	6	27	32	30	14	-10	-27	-23
Northpole-7	1957					M	M	M	25	7	2	-25	-38
"	1958	-30	-38	-28	-23	2	26	31	30	9	-14	-23	-27
Northpole-8	1959						M	M	M	M	M	M	M
"	1960	-29	-28	-23	-13	11	26	31	27	17	-1	-19	-22
"	1961	-27	-38	-34	-15								
Northpole-9	1960					14	(27)	31	29	20	-1	-17	-26
"	1961	-28	-38	-36									
Northpole-10	1961											-16	-27
"	1962	-21	-25	-20	-8	4	24	28	(24)	(16)	M	M	-34
"	1963	-36	(-34)	-42	-17	7	27	31	26	15	-10	-20	-25
"	1964	-42	-36	-34	-25								
Northpole-11	1962					6	25	29	(28)	(11)	M	M	-34
"	1963	-38	-30	-36	(-19)								
Northpole-12	1963					11	24	30	24	17	-10	-18	-19
"	1964	-42	-42	-38	-23	0	23	30	29	11	-4	-19	-36
Northpole-13	1964					10	28	31	30	14	-2	-14	-35
"	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-34	-26	-34	-15	6	22	31	29	14	-14	-18	-24
"	1967	-35	-46	-29									
Northpole-14	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	-35											
Northpole-15	1966				(-12)	6	23	30	29	10	-17	-21	-20
"	1967	-36	-41	-33	-15	7	24	31	27	20	-6	-19	-24
"	1968	-26	-36										
Northpole-16	1968					15	26	31	30	19	0	-31	-29
"	1969	-31	-34	-33	-18	8	26	29	27	20	-7	-22	-23
"	1970	-24	-31	-31	-22	10	22	30	29	11	-14	-25	-34 +
Northpole-17	1968						26	31	29	15	-7	-22	-33
"	1969	-30	-28	-43	-23	3	25	30	26	13			

TABLE VI (continued)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northpole-18	1968											-18	-22
"	1969	-19	-31	-28	-7	(9)	28	29	28	20	-6	-15	-19
"	1970	-22	-24	-25	-18	10	22	30	28	15	-6	-16	-27 +
Northpole-19	1969											-21	-21
"	1970	-21	-22	-21	-17	13	25	30	28	17	-3	-13	-26 +
Northpole-20	1970					(13)	(25)	(29)	(29)	(15)	-10	-17	-23 +
Fletcher's T-3	1952-58	M	M	M	M	M	M	M	M	M	M	M	M
"	1959	-38	-32	-40	-24	3	24	29	30	23	1	-19	-33
"	1960	-40	-21	-22	-13	16	28	31	30	19	4	-20	-16
"	1961	(-16)	-34	-26	-16	11	28	32	30	30	(18)	M	M
"	1962	M	M	M	M	M	M	M	M	M	M	M	M
"	1963	M	M	M	M	M	M	31	26	13	-7	-17	-23
"	1964	-42	M	M	(-13)	4	26	30	29	11	-8	M	M
"	1965-67	M	M	M	M	M	M	M	M	M	M	M	M
"	1968	M	M	M	M	M	24	29	28	5	-15	-36	(-29)
"	1969	(-40)	(-39)	(-44)	-30	2	24	27	22	7	-20	M	M
"	1970	M	M	(-49)	M	M	M	M	M	M	M	M	M +

TABLE VII: Mean Windspeed (miles per hour)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fram	1893										10.7	10.3	7.2
"	1894	8.1	8.1	10.3	9.2	11.4	8.0	9.8	7.8	10.7	12.3	8.9	13.0
"	1895	10.1	8.9	7.8	7.4	11.0	12.8	11.2	11.2	10.5	10.1	9.4	8.5
"	1896	12.1	13.2	11.0	10.0	11.0	9.2	8.0	13.9				
Maud	1922									11.9	13.0	9.4	9.6
"	1923	9.8	9.8	7.6	8.7	8.7	10.1	8.7	8.5	9.8	11.2	8.1	6.1
"	1924	8.7	8.1	5.8	9.2	7.8	8.9	6.7	9.2				
Sadko	1937										10.3	14.3	11.6
"	1938	14.8	9.8	8.3	8.9	10.3	13.0	10.7					
Sedov	1937											11.6	6.9
"	1938	10.1	9.1	8.6	8.1	9.9	9.7	13.0	12.7	15.2	11.9	14.1	16.3
"	1939	11.9	10.1	9.8	12.5	14.3	15.9	9.8	10.5	14.8	13.9	13.9	14.3
B.T.A. Trek	1968		(6.9)	8.1	8.1	11.5	9.2	9.2	9.2	8.1	10.4	9.2	10.4
"	1969	8.1	8.1	6.9	9.2	9.2	(8.1)						
Alpha	1957							9.0	10.6	6.6	11.4	6.7	4.2
"	1958	8.5	6.4	6.6	4.1	6.6	7.3	6.9	5.8	8.2	8.5	6.3	
Arlis-I	1960									12.2	14.4	10.6	13.6
"	1961	11.4	9.7	10.2									
Arlis-II	1961							10.7	12.0	11.5	9.9	15.1	8.4
"	1962	12.5	11.4	12.7	13.2	10.5	12.3	13.8	15.8	14.0	13.2	12.0	10.8
"	1963	9.8	10.6	11.3	10.1	10.1	8.3	11.3	10.6	12.5	13.8	12.2	12.7
"	1964	13.0	10.2	14.7	10.6	10.9	12.9	10.7	9.1	10.1	14.4	12.1	17.1
"	1965	16.0	16.4	13.9									
Charlie	1959						9.6	10.6	10.1	11.6	12.0	9.7	13.7
Northpole-1	1937						11.4	8.7	11.0	8.5	8.3	17.9	9.4
"	1938	9.4											
Northpole-2	1950				9.0	9.7	10.5	7.4	12.8	11.4	6.8	8.3	4.9
"	1951	10.2	12.0	6.9									
Northpole-3	1954								(8.3)	(9.1)	(11.1)	(6.9)	(7.3)
"	1955	(10.0)	(7.6)	(8.8)	(10.2)*	(10.0)*	(8.6)*						
Northpole-4	1954											14.5	15.0
"	1955	12.1	10.8	10.0	10.8	10.9	11.2	11.3	13.5	11.5	12.9	11.5	11.0
"	1956	16.0	14.8	12.4	10.6	10.4	(13.4)	(12.4)	M	M	M	M	M
Northpole-6	1956					10.7	13.7	15.2	10.6	10.9	13.6	8.7	12.3
"	1957	M	M	M	M	M	M	7.9	7.1	6.9	4.9	6.2	4.0
"	1958	4.9	5.6	5.1	5.1	4.6	3.8	5.5	8.1	6.4	5.5	6.9	6.3
Northpole-7	1957					7.7	11.5	M	8.7	5.4	8.3	4.4	3.4
"	1958	3.9	3.7	5.3	3.3	4.2	4.8	3.9	4.4	5.3	4.6	5.0	4.4
"	1959	6.9	10.5	13.6									
Northpole-8	1959						11.9	11.9	10.3	11.0	13.0	11.2	15.3
"	1960	10.4	12.8	12.8	11.9	10.6	11.6	9.3	7.6	12.6	13.1	11.0	11.7
"	1961	11.7	10.6	8.5	10.6								
Northpole-9	1960					10.5	11.1	10.3	12.3	10.4	12.2	10.1	10.0
"	1961	10.9	9.1	9.3									
Northpole-10	1961											14.1	8.1
"	1962	11.9	9.0	9.3	11.5	11.2	10.4	10.9	(16.7)	10.8	M	M	9.1
"	1963	7.2	(9.5)	6.0	8.4	6.9	8.0	9.1	9.4	11.6	8.5	11.3	11.7
"	1964	8.7	10.5	11.4	10.7								
Northpole-11	1962					11.1	11.2	12.9	13.0	13.2	M	M	9.1
"	1963	9.9	9.4	9.9	(13.9)								
Northpole-12	1963					6.4	7.8	6.2	12.7	14.2	9.5	12.0	12.8
"	1964	6.7	7.1	9.0	10.7	10.3	12.4	12.9	8.9	9.6	13.3	7.9	7.9

TABLE VII (continued)

STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northpole-13	1964					11.4	11.9	10.2	10.3	10.4	10.2	12.9	9.4
"	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	11.2	11.0	6.2	7.0	14.4	11.5	11.6	11.0	11.2	4.7	12.0	9.4
"	1967	10.6	8.9	11.0									
Northpole-14	1965	M	M	M	M	M	M	M	M	M	M	M	M
"	1966	7.8											
Northpole-15	1966				(7.7)	9.7	13.8	8.2	8.5	8.0	7.1	10.8	11.0
"	1967	8.3	9.6	10.1	11.5	9.5	9.9	9.4	11.7	8.9	12.1	10.6	9.5
"	1968	9.6	9.4										
Northpole-16	1968					11.7	11.4	9.7	10.2	11.8	10.6	6.0	11.1
"	1969	10.3	11.4	10.5	10.8	7.8	11.3	13.6	12.7	14.3	12.3	10.2	12.0
"	1970	15.0	8.4	11.1	7.7	10.0	10.6	12.2	10.1	12.0	10.8	7.9	9.0 +
Northpole-17	1968						10.4	10.8	11.4	10.0	14.7	12.5	10.0
"	1969	10.6	15.3	8.8	8.8	5.8	8.0	9.7	7.7	9.3			
Northpole-18	1968											10.3	10.7
"	1969	17.4	11.1	12.3	10.8	(9.9)	10.8	11.4	9.8	11.5	10.6	7.4	8.2
"	1970	8.1	8.0	5.2	9.6	10.8	11.1	11.5	8.9	9.6	7.9	9.3	7.5 +
Northpole-19	1969											8.1	12.3
"	1970	9.1	9.4	7.9	6.5	7.6	9.3	8.5	6.5	9.2	8.5	9.2	8.5 +
Northpole-20	1970					10.0	11.1	10.1	9.0	13.8	9.5	10.6	9.5 +
Fletcher's T-3	1952				9.6	12.2	8.3	10.5	11.3	12.1	11.4	7.6	10.2
"	1953	12.0	10.4	10.1	10.5	11.6	11.2	9.8	9.7	9.2	11.4	9.1	10.4
"	1954	7.5	7.7	7.9	9.1	M	M	M	M	M	M	M	M
"	1955	M	M	M	M	6.6	9.8	11.4	11.7	11.7			
"	1957							6.2	8.7	12.1	10.9	8.7	8.3
"	1958	15.8	13.8	9.3	10.2	9.1	7.8	10.0	7.6	9.1	7.4	10.7	13.0
"	1959	12.0	8.6	8.5	10.7	8.6	10.4	9.4	10.2	12.4	8.7	10.6	10.8
"	1960	(10.7)	15.9	12.9	11.2	14.8	8.9	9.3	12.1	12.5	19.0	11.9	14.5
"	1961	11.2	6.6	14.6	11.0	8.5	9.2	7.9	13.0	11.6	(12.0)		
"	1962					9.0	8.0	13.0	10.0	13.0	9.0	10.0	9.0
"	1963	7.0	8.0	8.0	9.0	9.0	8.0	9.0	13.0	11.0	13.0	8.0	10.0
"	1964	5.0	6.0	12.0	11.0	12.0	14.0	14.0	8.0	8.0	10.0	6.0	7.0
"	1965	9.6	10.7	11.2	9.4	9.4	8.3	8.7	9.8	10.1	11.4	11.4	7.2
"	1966	9.6	10.1	8.9	8.1	10.7	10.6	7.5	9.3	9.8	7.7	13.7	9.7
"	1967	9.3	9.2	8.3	11.3	10.0	10.4	9.1	11.9	7.4	12.2	8.5	8.2
"	1968	12.1	9.3	9.3	8.4	8.4	9.3	9.8	8.4	7.3	8.1	8.2	9.7
"	1969	6.9	6.8	6.8	7.5	6.4	9.4	12.2	9.9	10.9	10.0	M	M
"	1970	M	M	7.9	M	M	M	M	M	M	M	M	M +

APPENDIX C

TABLE OF CLIMATIC MEASUREMENT EQUIVALENTS
(for reference purposes when using the maps in Section 6)

Temperature

Degrees F	Degrees C
50	10.0
45	7.2
40	4.4
35	1.7
32	0.0
30	-1.1
25	-3.9
20	-6.7
15	-9.4
10	-12.2
5	-15.0
0	-17.8
-5	-20.6
-10	-23.3
-15	-26.1
-20	-28.9
-25	-31.7
-30	-34.4
-35	-37.2
-40	-40.0
-45	-42.8
-50	-45.6
-55	-48.3
-60	-51.1
-65	-53.9
-70	-56.7

Windspeed

Miles per Hour	Meters per Second	Knots
1	0.447	0.686
2	0.894	1.372
4	1.788	2.744
6	2.682	4.116
8	3.567	5.488
10	4.470	6.860
12	5.364	8.232
14	6.258	9.604
16	7.152	10.976
18	8.046	12.348
20	8.940	13.720
25	11.175	17.15
30	13.410	20.58
35	15.645	24.01
40	17.880	27.44
45	20.115	30.87
50	22.350	34.30
55	24.585	37.73
60	26.820	41.16
65	29.055	44.59
70	31.290	48.02
75	33.525	51.45
80	35.760	54.88
85	37.995	58.31
90	40.230	61.74
95	42.465	65.17

1 F° = 0.555 C°
1 C° = 1.800 F°

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13. ABSTRACT

This report contains maps showing the distribution of monthly means and extremes of temperature, windspeed, dewpoint, and visibility within the Arctic Basin. These elements were selected because of their significance to the design and operation of large, Surface-Effect Vehicles which may be required to perform transportation services in that area. The distributions are derived from a considerable amount of observational data spanning a century of scientific research but primarily from Soviet and United States drifting ice stations maintained during the last two decades.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Surface climate						
Arctic Basin						
Surface Effect Vehicles						
Climatic extremes						
Climatic frequencies						
Drifting ice stations						
Temperature						
Windspeed						
Dewpoint						
Visibility						
Hydrometeors						